ALTERING BARRIERS TO PHYSICAL ACTIVITY AND EXERCISE IN RURAL KANSAS THROUGH EDUCATION AND EXERCISE INTERVENTIONS

By

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ABSTRACT

Rural Americans (RA) report significantly higher percentages of obesity, chronic disease, and cognitive decline than urban-dwelling Americans. However, rural individuals face different barriers to physical activity and exercise than their urban counterparts. **PURPOSE:** The purpose of this study was to increase physical activity among middle-aged and older adults living in rural Kansas, increase Alzheimer's disease knowledge through risk reduction education, and determine the unique barriers to physical activity and exercise in this rural Kansas cohort. **METHODS:** Sixty-nine rural dwelling adults (17 male, 52 female; mean age 63.9±7.95 years) participated in a 10-week community-based education and exercise intervention program in rural Kansas. Baseline physical fitness (Queen's College Step Test, blood pressure), balance and muscular endurance (30-second chair sit and stand), quality of life (OPQOL), healthy lifestyle survey (HLPLII), and Alzheimer's disease knowledge (ADKS) assessments were collected prior to participation. Subjects were randomly assigned to one of three groups and participated in either 10 weeks of education (ED), education and exercise (EDEX), or were assigned to the control group (CON). Sixty-nine (69) participants completed the 10-week study and completed follow-up assessments. A cohort of subjects (N=23) participated in interviews throughout the course of the study. Repeated measures ANCOVAs were conducted to determine differences, if any, in the dependent variables before and after interventions (p<.05). Small group interviews were conducted throughout the study period to assess views and attitudes toward exercise and physical activity and determine perceived and actual barriers faced by rural Kansas adults. Interview response

frequencies and differences, if any, were determined for barriers to, benefits of and opportunities to participate in exercise and physical activity. **RESULTS:** The EDEX group acquired significantly more steps on average throughout the study period than the CON group, but not significantly more than the ED group (p<.05). Chair test scores improved significantly for the EDEX group compared to both the ED and CON group (p<.05). Weight and waist to hip ratio improvements did not differ significantly between groups. Scores on the HLPLII, both overall and the physical activity component alone, improved significantly for the EDEX group compared to both ED and CON groups, p<.05). Quality of life scores (OPQOL) were significantly higher for the CON group than the ED and EDEX group (p<.05). Time, lack of motivation and injury or illness were the most commonly reported barriers to exercise, while brain health and overall health were the most commonly reported benefits of exercise. Rural Kansas adults were able to successfully distinguish between physical activity and exercise and identify numerous opportunities for exercise and physical within the surrounding rural communities. Response frequencies did not differ significantly between groups (p<.05).

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Chapter 1: Introduction

Rural Americans, Exercise and the Aging Brain

Rural Americans (RA) report significantly higher percentages of obesity and chronic disease than their more populated, urban counterparts[1,16]. However, rural individuals face different barriers to physical activity and exercise than their urban-dwelling individuals [1,11,15]. Such barriers include safety, sidewalk accessibility, misconceptions about physical activity and exercise, chronic illness, and caregiving responsibilities, among others[11, 15].

Lack of knowledge may also pose a potential barrier for RAs[15]. The belief among RAs that physical activity and/or exercise is too strenuous may in fact prevent individuals from engaging in recommended physical activity necessary to attain a healthy lifestyle. Clinicians know that exercise, more specifically cardiovascular exercise, has been shown to be a powerful tool for reducing the risk of chronic diseases and diseases of cognitive decline, such as Alzheimer's disease.[3-10,17] However, obtaining the recommended amount of cardiovascular exercise may pose a greater challenge for individuals living in rural communities, as they are further from exercise facilities and the presence of sidewalks is often limited.[11,12,15,53] All of these barriers may increase the risk of dementia and chronic diseases among rural residents. Dementia rates remain higher in rural populations and may be related to the higher prevalence of obesity-related behaviors and lack knowledge regarding risk-reducing behaviors.[1,2,12,16,18]

RAs also report lower educational attainment, less daily physical activity (both by choice and due to chronic health conditions), higher all causes of death rates, and greater use of tobacco products among all ages [14]. Physical activity and exercise result in a number of positive

adaptations, including, but not limited to, increased cardiovascular health, improved insulin sensitivity, and increased muscle mass. But PA and exercise also have been linked to improve cognition and reduced risk of dementia. Research suggests that improving heart health is associated with lower risk for dementia.[3-5,10,17,25,27-30,34-39,41-45,47] In fact, remaining physically active throughout life has been shown to reduce the risk of dementia as well.[6-9,34,35,40]

Given that nearly 50% of all individuals are likely to experience some form of cognitive decline by age 85, [46] it is imperative that preventative measures be integrated into communities. Rural populations require such programs to be tailored to their specific needs. Risk reduction education is essential to address and preclude further health disparities in these underserved communities.

The scientific community and national agencies have recognized the need for investigations that strive to build a collaborative culture of health in the United States. Currently, treatment options for individuals with AD are primarily pharmaceutical. This type of treatment is not only costly but offers little hope to recover a beloved family member affected by this degenerative disease.

Six key lifestyle behaviors have been identified as AD risk reducing behaviors. These six behaviors are physical activity and exercise, nutrition, social engagement, cognitive engagement, socialization, sleep, and stress management. Research suggests that individuals who regularly practice these healthy lifestyle behaviors are at a lower risk of developing cognitive impairment than those who do not.[13] Of these six key behaviors, diet and exercise appear to be the most powerful tools for prevention. [5-10,13,17,27,29,30,34-45] Cardiovascular exercise has received the strongest support for staving off cognitive decline [1,4-10,17]. This mode of exercise requires little

equipment and could prove to be an extremely cost-effective means of preventing and possibly reversing cognitive decline.

Until science can offer ways to alter this devastating disease (AD), exercise may be the most powerful treatment available. If investigations could effectively utilize education and exercise to prevent, and possibly reverse, AD, healthcare as we know it could be dramatically altered. Public health could be significantly improved through preventative measures, costing individuals and families much less than corrective and pharmaceutical measures.

In 2016, The University of Kansas Alzheimer's Disease Center (KU ADC) developed a curriculum aimed at reducing risk factors for in cognitively normal adults. This curriculum, called LEAP (Lifestyle Empowerment for Alzheimer's Prevention), utilizes current research to provide practical lifestyle strategies linked to AD risk reduction. The LEAP curriculum has been piloted at an affluent senior living community with highly educated residents in the Kansas City metropolitan area and received favorable reviews, rating the applicability to daily life as 4.75/5 and the format as enjoyable 4.8/5 (unpublished data).

Purpose

The purpose of this intervention was to determine if 10 weeks of community-based education and/or exercise could increase chronic disease knowledge, increase physical activity levels, and improve healthy lifestyle behaviors in rural Kansans. The long-term goal of this work is to reduce the prevalence of cognitive decline in adults living in rural Kansas through education and exercise interventions.

Rationale and experimental approach to the problem

Effective community-based intervention programs are necessary to address the need for chronic disease education and lifestyle behavior change in rural communities. Necessary measures need to be taken to combat the disproportionately high rates of chronic illness, cognitive decline, and lower educational achievement in these remote areas. Studies suggest social support may play an integral role in exercise adherence and motivation. If this is true, group education and exercise programs like LEAP! may play a significant role in educating the rural public and decreasing health disparities among less populated regions.

If shown to be successful in increasing positive lifestyle behavior and increasing understanding of cognitive decline, the LEAP! program could be packaged and administered to other rural communities. Current treatment options for individuals with AD are primarily pharmaceutical. This treatment is costly and offers little hope to recover a beloved family member after this terrible disease has gripped the life of that individual. We sought to provide a cost-effective, adaptable preventative treatment option for older adults living in rural America.

To determine the effectiveness of the LEAP! curriculum in rural Kansas, three specific aims were established. These aims were tested through a randomized controlled trial utilizing repeated measures Analysis of Variance with covariates (ANCOVA).

Aim 3 investigated the effectiveness of the community-based interventions at increasing physical activity and physical fitness measures in rural Kansas adults. Aim 2 tested the ability of the LEAP! curriculum to improve AD and AD risk knowledge in rural Kansans. Aim 3 sought to determine the unique barriers to physical activity and exercise in rural Kansas communities. This was assessed through focus group interviews. Figure 1 illustrates the general research design and procedures. Participants who met the inclusionary criteria were randomly assigned to one of

three study groups (ED EDEX or CON). Measurement of the dependent variables occurred at baseline and again upon completion of the 10-week study.

Subjects recruited to participate in this study were adults over the age of 50, living in a federally designated rural or frontier county, willing to drive to Emporia, Kansas for community-based education and/or exercise sessions. Participants were screened and determined to be underactive adults as determined by the telephone assessment of physical activity (TAPA).

Independent Variables

Subjects were then randomized into three study groups and followed the associated protocol for the duration of the study.

Dependent Variables

Dependent variables included physical fitness performance testing (aerobic fitness and muscular endurance), anthropometric measurements, AD knowledge, quality of life (OPQOL), and a healthy lifestyle profile assessment (HLPL-II). Testing included an aerobic fitness test as well as a muscular endurance assessment. This muscular endurance test is also a validated measure of fall risk.

Blood pressure (BP) was measured after subjects had been sitting quietly for at least 3 minutes, using a standard electronic blood pressure cuff. Following BP measurements, girth measurements, height, and weight were measured.

Ample time was provided (e.g., 45 minutes) for each subject to complete each survey and the research team was available to provide question clarification as needed.

Aerobic fitness was tested by performing the Queen's College Step Test. Three step heights were utilized to address individual abilities (individuals used the same height step for both pre- and post-testing). Step cadence was performed as designated by the test protocol (88 bpm for women; 92 bpm for men). The 30-second chair sit and stand test was used to assess muscular endurance and risk of falls. The same chair was used for all test trials. All physical fitness performance tests were conducted in a laboratory setting using the same equipment and research personnel. Protocol for all assessments can be found in the appendices.

Hypotheses

Hypothesis 1: Physical Activity.

We expected both experimental groups (ED and EDEX) would increase physical activity levels after 10 weeks, and that the EDEX group would see the most significant improvements in physical activity levels.

Hypothesis 2: AD Knowledge.

The research team expected AD knowledge would improve compared to baseline in both ED and EDEX groups. We do not expect AD knowledge to increase among control participants.

Hypothesis 3: Barriers to Exercise.

Responses from focus groups interviews in rural Kansas will provide vital information regarding current and future barriers to physical activity, exercise, and AD prevention in similar rural communities. We expect these perceived barriers to be similar to those previously reported in the literature.

Definitions

Rural Kansas, for the purposes of this study, refers to federally designated rural or frontier counties within the state of Kansas (60+ miles from the nearest city of 50,000 or more). Older adults included in this study ranged in age from 50 years to >80 years of age. Cognitively normal refers to individuals free of diagnosed cognitive decline of any type. This does not include diagnosed mental disorders, such as depression, anxiety and other mental disorders.

Limitations and Delimitations

One limitation of the current study is our ability to directly measure aerobic intensity levels during exercise. Funding for this project allows for the purchase and use of physical activity tracking devices that measure step count, sleep patterns and record intensity minutes. However, these devices do not measure heart rate. Thus, exercise intensity was measured using a modified rate of perceived exertion scale (RPE). Because many people exercise without the use of a heart rate monitor, using RPE was very relevant and applicable to the study population.

A key delimitation of this research study is the population itself. While the goal of this study is to evaluate perceived barriers, physical activity, AD knowledge and quality of life in rural Kansas, the findings of this study are somewhat limited in applicability. The results of this study are directly relevant to other rural Kansas communities, but may not be directly applicable to other rural populations throughout the United States (i.e. rural Northeastern United States, rural Southern United States, etc.).

Another important delimitation of this study is the population we chose to work with. Studies on rural population behavior change and AD knowledge are extremely limited and must be expanded upon. No studies to date have examined the effectiveness of an Alzheimer's prevention program in a rural population. As obesity and chronic disease rates continue to

increase in the United States, community health initiatives may provide a viable solution to this growing epidemic. Research studies are necessary to address this community-based education and exercise program delivery.

Assumptions

We assume that all participants were truthful with inclusionary criteria at the beginning of the study and appropriately notified us if any aspects of inclusion changed at any time throughout the study. We also assume subjects put forth their best effort during physical fitness tests at all time points. We assume that study participants did not discuss study materials outside of class discussions and exercise sessions, especially with control group subjects they may be acquainted with. And finally, we assume that subjects completed all survey assessments truthfully during both pre- and post-assessments.

Figure 1 General research procedures

Screening

Enrollment Evaluation

- Healthy, underactive, 50 yrs+, residents of Rural KS

n = 93

Availability

- Attend minimum 8 weeks of education/exercise sessions

Enroll N = 75

Baseline
(1 visit)
1st Measures

- Surveys
- Height
- Weight
- Girth

2nd Measures

- BP
- Physical fitness assessments

Weekly

- Educational sessions
- Self-reported physical activity data (# steps)

Follow-Up
(1 visit)
1st Measures

- Surveys
- Assess. of Program
- Height
- Weight
- Girth

2nd Measures

- BP
- Physical fitness assessments

Chapter 2: Literature Review

<u>Worldwide Physical Activity and Exercise Trends</u>

Despite the many well documented benefits of physical activity, as few as 50% of adults and 25% of high school students meet the minimum recommended physical activity guidelines for aerobic activity. National governing bodies, including the American Council on Sports Medicine and The Center for Disease Control, recommend a minimum of 150 minutes of moderate-intensity aerobic physical activity weekly. [32,33] A worldwide assessment of current physical activity levels found that Americans, on average, walk less than 5,000 steps daily, or approximately 2.5 miles per day[32]. The United States currently ranks in the top five for physical activity inequality, with women acquiring significantly less steps per day than men. The United States is not alone in this regard. Women report less physical activity in all 46 countries reporting data. According to the 2017 study, not a single country worldwide met the arbitrary 10,000 daily steps benchmark, with average daily step count maxing out near 6,000. This sedentary lifestyle is associated with obesity, increased rates of type II diabetes and numerous other chronic health conditions, including cognitive decline [33].

<u>Physical Activity, Exercise and the Aging Brain</u>

It is not surprising that individuals at risk for other chronic diseases also at are higher risk for developing AD. Insulin resistance (Type II Diabetes), cardiovascular disease, inflammation and other mechanisms all appear to be a good marker for AD risk.[27-30,37,38] Exercise and diet are lifestyle factors known to help control blood sugar levels and body weight, increase circulation and cardiovascular fitness, and reduce inflammation, which give individuals the ability to prevent or reverse these chronic ailments and, therefore, reduce the risk of developing any form

of dementia. Individuals willing to participate in structured cardiovascular exercise thus have the power to both improve insulin sensitivity and potentially inhibit cognitive decline. This powerful tool is both free to the individual and readily adaptable to each person's fitness level.

It is well documented that aging results in neurological changes in the human brain.[27] These changes (white matter atrophy, degeneration, hyper-intensities, etc.) have been directly linked to common signs of aging such as gait and balance disorders and cognitive decline[19, 25,26]. White matter change is prevalent in elderly individuals suffering from Alzheimer's disease, Parkinson's disease, and those who have suffered one or more strokes[26]. Severity of white matter abnormalities have been linked to severity of gait and balance deficiencies, walking speed and physical inactivity[19]. These white matter changes are associated with the onset and progression of AD. Exercise has been investigated as a means of slowing down the speed at which these neurological changes occur. In addition to preventing degenerative neurological changes, exercise blunts the effects other deleterious age-related deficits (sarcopenia, loss of coordination, impaired glycemia, etc.) and often offers social benefits[23,27,28]. Exercise offered in group settings has been shown to effectively increase physical activity in daily life[23] body composition, muscular strength, quality of life and slow down progression of mild cognitive impairment in older adults[22, 28].

Exercise has successfully been found to improve a multitude of cognitive processes, including cognition and brain function efficiency, as well as spared brain volume[27]. Both resistance and cardiovascular exercise positively impact executive functions in aging adults, with cardiovascular exercise most effective as increasing activity in the frontal and parietal regions of the brain; regions associated with efficient attention control[27].

Both men and women have the capacity to successfully preserve cognitive function and brain volume through physical activity. Women who report higher levels of physical activity throughout a lifetime also experience lower prevalence of cognitive decline later in life. Higher volumes and intensities of physical activity have been directly correlated to improved neurological function and brain matter[17,28,29]. In fact, recent findings suggest the cardiovascular fitness level of an individual, as opposed to the duration of a given workout, is a more specific predictor of cognitive response in older adults at risk for AD[17].

The scientific community, as well as the fitness industry, acknowledge the positive correlation between physical activity and cardiovascular health. But science also suggests that physical activity (more specifically, moderate-intensity exercise) is beneficial for brain health as well [5-10,13,17,27,29,30,34-45]. Studies suggest that physical activity and exercise have the ability to promote positive cognitive performance and brain plasticity in aging adults, both of which are inversely related to cognitive decline. Chronic physical activity over the life span is associated with reduced risk of cognitive decline and increased cognitive and functional performance. A 2010 study used logistical regression to assess likelihood of cognitive impairment based upon self-reported physical activity throughout life span of female participants. Participants were asked to report regular physical activity levels during four different ages: teenage, age 30, age 50 and late life. After adjusting the models for age, education, marital status, related chronic diseases, smoking and BMI, investigators found that women who participated in regular physical activity had significantly lower prevalence of cognitive decline [40]. While physical activity at any age was found to be predictive of successful aging (low incidence of cognitive decline), women who were physically active as teenagers had the lowest prevalence of cognitive decline in older age. Previously sedentary women who initiated regular physical activity or exercise routines at

any of the later ages (30, 50 or late life) also significantly reduced their risk [40]. Reviews of physical activity intervention research suggest that physical activity and exercise may very well be the best preventative available for both preventing chronic disease (type II diabetes, cancers and cardiovascular disease, among others) and cognitive decline [35]. Chang et al. found that active older adults performed better on assessments of processing speed, memory and executive functions, independent of cardiovascular fitness level. As little as 5 hours per week of physical activity was linked to lower dementia rates later in life [48]. Larson and colleagues' findings support these results. In a study of 1,740 older adults (65+), Larson found a strong correlation between regular exercise and reduced dementia rates. Exercising three or more times weekly was associated with a 32% reduction in dementia risk [49].

Physiological mechanisms have been found to explain the relationship between physical activity and brain health. Physical activity is associated with neurogenesis in the hippocampus in elderly mammals and exercise is known to produce changes in molecular growth factors like brain-derived neurotrophic factor (BDNF) and insulin-like growth factor 1 (IGF-1). BDNF plays an integral role in neuroprotection and brain plasticity, while IGF-1 is associated with both neurogenesis (creation of new neurons) and angiogenesis (creation of new blood vessels) [35]. Human studies reveal that higher cardiorespiratory fitness levels are associated with reduced loss of brain volume; both gray matter and white matter [44], larger hippocampal volume and better performance on special memory assessments [27,37].

Burns et al. investigated the effect of cardiorespiratory fitness level on both cognitively normal and cognitively impaired individuals and found correlations between cardiorespiratory fitness and cognition [47]. Results also showed that cognitively normal individuals with higher

fitness levels had less brain atrophy and greater overall brain volume. These results held true even after adjusting for age, sex, dementia severity and physical frailty [47].

Colcombe and colleagues found aerobic exercise to be an effective means of sparing brain tissue and improving cardiorespiratory fitness in older adults.[44] Not only was aerobic exercise effective, but it was determined to be superior to stretching and toning exercise of the same duration. Participants who performed six months of thrice weekly aerobic exercise at moderate intensity saw significant improvements in cardiorespiratory fitness as measured by VO_{2peak}. Aerobic training resulted in an average 16.1% increase in VO_{2peak} compared to a non-significant 5.3% increase in the stretching and toning group. Aerobic exercisers also showed greater increases in brain volume than the non-aerobic group. Further analysis revealed a significant risk reduction associated with aerobic exercise in four regions of the brain: the anterior cingulate cortex, right superior temporal gyrus, right middle frontal gyrus and anterior white matter clusters. While the sample size for risk reduction conclusions were smaller than desired (n=59), the results suggest that improving aerobic fitness is not only good for the heart, but for preserving brain tissue as well.

Aerobic exercise very well may serve as an effective and affordable preventative measure against cognitive decline. But it may also provide a viable treatment option for physicians to prescribe to demented patients. In 2008 Burns et al reported that patients in the early stages of AD with greater aerobic fitness experienced less whole-brain atrophy than their less aerobically fit counterparts.[50] After controlling for potentially confounding variables, the relationship remained significant. Both white matter and total brain volume remained higher among patients who had higher aerobic fitness levels.

Results from a 2010 study support these findings.[30] Baker and colleagues found aerobic exercise to be effective at improving a number of performance and physiological measures in individuals with mild cognitive impairment. Interestingly, the effects of aerobic exercise seemed to be sex specific. While females with mild cognitive impairment improved performance on tasks of executive function and a reduction of certain hormones (insulin, cortisol and brain-derived neurotrophic factor), men experienced increased levels of IGF-1 and only improved performance on a single performance measure (Trials B test).[30] This variation may be explained by gender specific metabolic effects of exercise. In this particular study, glucoregulation and insulin sensitivity improved following six months of aerobic exercise in women, but not for men. Cortisol levels decreased in females, but increased in male subjects after six months, when compared to control subjects (stretching and toning). Aerobic exercise led to greater improvements (reduced cortisol) in women, while stretching and toning resulted in reduced cortisol among men. Finally, aerobic exercise resulted in mean plasma levels of β-Amyloid decreasing for both genders while control subjects' β-Amyloid levels increased (24%). However, neither were statistically significant.[30] While these results do not seem conclusively positive for both males and females, they may help investigators understand and more effectively address AD risk gender disparities. Women are at greater risk for developing AD than men. Aerobic exercise may provide a means of reducing this sex difference.

The hippocampus is the region of the brain responsible for memory storage and conversion, as well as a number of physiological mechanisms. In late adulthood, the hippocampus atrophies, similar to atrophy of the muscular system. Excessive atrophy is known to be a precursor for cognitive decline.[51,52] In 2010, Erickson and colleagues investigated the effects of aerobic exercise training on hippocampal volume and atrophy.[37] Magnetic resonance

imaging (MRI) revealed selective increases in hippocampal volume following twelve months of moderate intensity aerobic training. Regular moderate intensity aerobic exercise was successful at increasing hippocampal volume in both the right (1.97%) and left regions (2.12%). In contrast, stretching and toning for twelve months resulted in significant atrophy of the same hippocampal regions (-1.43%, -1.4%). More specifically, the anterior hippocampus, responsible for cell proliferation, was positively affected, while the posterior region remained unchanged. Cells in the anterior region are associated with spatial memory acquisition and tend to show greater atrophy than the posterior region as adults age. A significant time x group interaction was found for aerobic fitness level and hippocampal volume. The fitter individuals became, the greater the hippocampal volume. Additionally, individuals in the control group who had higher baseline fitness levels tended to experience less hippocampal atrophy over the course of the study. However, only the right anterior hippocampus experienced this protective effect of baseline fitness. The left region was not affected by initial fitness level.[37] Further analysis revealed a significant relationship between circulating levels of BDNF and hippocampal volume. BDNF is known to increase with exercise and is associated with partial mediation of exercise's effects on memory and learning. Moderate intensity aerobic exercise increased circulating BDNF and was positively correlated with increased volume in the right and left anterior hippocampus. The posterior hippocampal region remained unaffected. Finally, the relationship between spatial memory and hippocampal volume was assessed. Both control and intervention groups significantly improved both memory (accuracy on memory test) and response time from baseline to postintervention. The aerobic exercisers did not improve memory performance above that of control subjects. Neither change in aerobic fitness level nor increased BDNF were associated with improved memory for either group or the entire sample. However, hippocampal volume

was found to augment memory performance in the aerobic exercise group.[37] While aerobic

fitness levels may not be directly associated with improved memory, aerobic exercise appears to

be an effective means of increasing hippocampal volume, thus leading to enhanced memory.

Vidoni and colleagues found a dose-response relationship between the volume of aerobic

exercise and cognition in 2015 [17]. Participants performed either 0, 75, 125 or 225 minutes of

moderate-intensity semi-supervised aerobic exercise 3-5 days a week up to 50 minutes per

training session. Intensity, as measured by percent heart rate reserve (% HRR) was gradually

increased throughout the 26-week period until individuals were able to exercise at 60-75% HRR.

After 26 weeks, all experimental groups had significantly improved their cardiorespiratory

fitness (VO_2 peak). Investigators also reported a dose-response relationship between training

volume and VO_2 peak. Perceived disability was found to be a function of exercise dose (higher

exercise volume = lower perceived disability). These results also applied to Visuospatial

Processing; as exercise duration increased, Visuospatial Processing improved. Upon further

analysis, it was determined that improvement in cardiorespiratory fitness fully mediated the

dose-response relationship between exercise duration and changes in Visuospatial Processing,

rather than solely exercise duration [17]. It appears that improving cardiorespiratory fitness may be

more important than the amount of time or distance covered during aerobic training sessions. For

sedentary populations, this is quite promising. Small, incremental improvements may lead to

significantly better cognition. The ability to tailor aerobic exercise prescription to each individual

may also allow for greater exercise adherence for individuals unaccustomed to regular,

structured exercise.

Physical Activity and Exercise in Rural America

Rural Americans (RAs) face unique barriers to physical activity and exercise compared to urban or metropolitan dwelling Americans. Several factors contribute to physical activity levels of any given population, including walkability, personal and cultural perceptions of exercise and physical activity, environmental factors and education, to name a few [11,15]. Common barriers faced by RAs are sidewalk availability, indoor walking spaces, safety, wanting to feel attached/community and lack of companionship, among others[11, 15, 31]. Knowledge may also pose a potential barrier for RAs[15]. The belief that physical activity and/or exercise is too strenuous may in fact prevent individuals from engaging in recommended physical activity necessary to attain a healthy lifestyle. Clinicians know that exercise, more specifically cardiovascular exercise, has been shown to be a powerful tool for reducing the risk of chronic diseases and cognitive decline[3-10,17]. Studies have shown time and again that improved cardiovascular function and regular physical activity are beneficial for optimal brain health.[3-10,17,25,27,29,30]

Obtaining the recommended amount of cardiovascular exercise may pose a greater challenge for individuals living in rural communities, as they are further from exercise facilities, and the presence of sidewalks is often limited.[11] These barriers must be considered when designing AD risk reduction education and exercise intervention strategies. Individuals who are rural, less educated and over the age of 70 show particularly sedentary behavior[11]. When compared to urban dwelling citizens, RAs have higher body mass indices, less regular physical activity, more numerous perceived barriers to physical activity, and less access to resources and education[11, 15, 31]. These rural populations are at higher risk for developing AD, as well as a myriad of other chronic health conditions [16]. For this reason, this investigation attempted to provide a means of combatting the exceptional number of perceived barriers and confounding risk factors RAs face.

As Nagamatsu and colleagues asserted in 2014, despite the accumulating evidence for exercise as a preventative tool, physicians, academics, and the public alike are reluctant to embrace and exercise as a preventative health tool.[34] Without education and organized community-based interventions, it is unlikely that RAs will increase participation in exercise on their own. The Rural Healthy People 2020 Initiative reported that while 17% of the United States population (59 million people) live in rural communities, only 9% of registered physicians practice in these areas. Rural health priorities have remained relatively constant over the past decade. Rural health stakeholders still identify access to services as the primary health concern.[53] The next seven priorities are all directly related to risk factors associated with AD. Physical activity, weight status, nutrition, exercise, older adults, diabetes, cardiovascular disease (CVD) and substance abuse all fall within the top ten health concerns of rural health stakeholders.[53] Individuals with type II diabetes, CVD and obesity-related conditions have a higher risk for AD than healthy adults.[5,7,27-30,35,38,40] Rural residents are less likely to complete both high school and college compared to urban residents, contributing to the lack of health education among this population.[1,53,57] The goal of Rural Healthy People 2020 is to address the lack of effort previously applied toward reducing rural-urban health disparities and serve as a resource for public policy leaders. Until 2015, the national initiative, Healthy People 2020, had put forth very little emphasis on rural community health.[53]

Analysis of the 1999-2006 National Health and Nutrition Examination Survey (NHANES) revealed distinct differences in obesity rates and obesity-related behaviors in rural adults compared to urban adults.[54] Overall rates of obesity, lack of physical activity, chronic disease and dementia continue to rise, and rural adults are at increased risk. According to NHANES results, nearly 39% of rural adults report no leisure-time physical activity and only

41.5% met or exceeded the national recommendations for physical activity. RAs consume less

fiber and fruit than urban adults and consume more sweetened beverages, contributing to obesity

and chronic disease rates. RAs were determined to be 1.19 times more likely to be obese than

urban dwelling adults. 33% of rural dwelling adults over the age of 60 were found to be obese,

with men having slightly higher obesity rates than women.[54] When these data were analyzed

further to include only data from 2005-2008, rates of obesity increased dramatically. 39% of RAs

(all ages) were found to have BMI values greater than 30.0, deeming them obese by national

guidelines. 37.9% of older rural adults (aged 60-75) had BMI values above 30.0, categorizing

them as obese. Additionally, greater than 65% of RAs failed to meet the recommended 150

minutes of weekly moderate intensity physical activity. 17% of rural adults failed to graduate

high school, 54.3% graduated from high school and had completed some college education, and

only 28.4% had a college degree or higher.[12]

There are many factors that contribute to the higher obesity, chronic disease and dementia

rates in rural America. Cultural norms and attitudes toward exercise may be some of the most

powerful determinants of physical activity and exercise. A 2010 investigation sought to

understand the underlying culture among low-income rural populations as it applied to

preventative health strategies.[31] Six focus groups were utilized to identify personal, cultural and

external barriers to participation in a community-based outreach program. The program of

interest provided various health screenings and attempted to address the need for transportation

and healthcare costs. Four main barriers emerged from these focus group discussions. Time, low

priority, fear of the unknown and lack of support were all perceived barriers to participation.

When asked to identify incentives to participate, rural residents reported addressing health

concerns, free services, engaging/enjoyable activities and free food as potential motivators.[31]

This valuable feedback is necessary for public health officials, community health practitioners and investigators to design and implement successful health outreach programs in rural communities that reduce disease risk and promote health aging.

Focus groups have also been used to gain a better understanding of the unique views of and attitudes toward exercise among rural dwelling seniors.[15] Aronson et al.'s 2004 study is closely related to the population of interest for the proposed study. Participants residing in rural Oklahoma were invited to participate in focus group interviews. 26 participants from Ada (n=14) and Lindsey, Oklahoma (n=12) participated in the exploratory interviews. Ranching and farming are prevalent in this region of Oklahoma. Results revealed that knowledge of physical activity and exercise was severely lacking.[15] Participants were asked to explain the difference between physical activity and exercise, report typical activities of daily living (ADLs), and identify opportunities to participate in physical activity and the barriers that prevent them from doing so. The majority of respondents were unclear on the distinction between physical activity (PA) and exercise, often citing PA as more difficult than exercise. Safety and lack of indoor facilities for PA and exercise were commonly cited barriers. In addition to these barriers, some rural seniors expressed concern about mixed messages from physicians as a barrier to participation in exercise.[15] The results from this study can be directly applied to future community-based exercise interventions in rural communities especially those similar to the Midwestern towns investigated.

An assessment of the resources and physical setting is necessary prior to program design. Developing consistent language is an important factor to consider when designing community-based programs as well. Defining terminology and adhering to the correct use of such

terminology will not only provide a consistent environment, but also provide public health education to rural residents.

Resistance Training and Cognition

Although aerobic exercise has been most widely investigated, resistance training has been investigated by a smaller number of research teams with promising results. Investigators at the University of British Columbia are particularly interested in the potential benefits of resistance training on cognitive performance and brain plasticity.[34] Nagamatsu and colleagues' 2014 study highlighted the work done to date regarding exercise and cognitive decline and attempted to address several factors that affect exercise adoption and adherence.[34] As this publication points out, extensive research supports the use of exercise as a viable treatment and potential prevention option for both mildly demented individuals and the worried well (cognitively normal adults). Despite the building evidence in support of exercise, the number of physicians prescribing exercise for cognitive outcomes is limited.

Nagamatsu and colleagues demonstrated in 2012 that six months of resistance training improved executive function, spatial memory and associative memory in older adults with probably mild cognitive impairment.[36] 86 senior women (70-80 years) with subjective memory complaints performed six months of either twice weekly aerobic exercise, resistance training exercise or balance and toning exercise. Resistance training was found to elicit significant improvements in a number of cognitive performance measures. These changes were also associated with functional plasticity.[36] Functional MRI was used during the associative memory task to assess functional changes in various regions of the cortex during a memory task. Statistical analyses revealed significant changes in the right lingual, occipital fusiform gyrus and

right frontal pole during encoding and recall associations. It is important to note that these significant improvements were gained after six months of only twice weekly resistance training. Further investigation is needed to determine the effects of resistance training frequency and intensities. As mentioned, the investigation also included an aerobic training group and a stretching and toning control group. As expected, no significant gains were made by the control participants. Aerobic exercise resulted in significant improvements in balance, mobility and cardiorespiratory capacity compared to the control group. These results support the use of both aerobic and resistance training for cognitive performance and physical fitness improvements. Resistance training can be performed in a variety of structures, thus providing older adults with a wide array of exercise program structures to choose from.

Previously, Liu-Ambrose and colleagues demonstrated that 12 months of resistance training (both once weekly and twice weekly) resulted in significantly improved scores on the Stroop Test in cognitively normal older women (aged 65-75 years).[39] Older women participated in upper body, lower body and total body strength training exercises once or twice weekly over the course of one year. The Stroop Test, a common cognitive assessment improved significantly from baseline to postintervention among both groups. In addition, task performance and peak muscle power improved significantly following one year of resistance training. Improvements in selective attention and conflict resolution were significantly associated with faster gait speeds.[39] Apraxia is often associated with cognitive impairment, thus increased gait speeds may be a potential marker of cognitive improvements in older adults. This study was the first to investigate the effects of resistance training on cognitive performance among older women.

Additional studies are needed to support the relationship between resistance training and cognition. Given the rising obesity rates of young and old populations alike, it is imperative that

exercise programs appeal to the masses and result in exercise adherence. Unless individuals adopt and adhere to exercise training programs, chronic disease prevalence and rates of AD will continue to increase in the United States.

Community-Based Intervention Programs for Older Adults in Rural and non-Rural Settings

The body of community-based intervention health education and exercise intervention research is lacking. While numerous community-based studies have been conducted in previous years, few have addressed the need for health education and exercise interventions in rural America, and to the best of our knowledge, none have been set in rural Kansas.

Watts et al. published recent findings citing neighborhood characteristics as important variables for promoting physical activity among older adults.[55] Investigators evaluated the role of neighborhood connectivity and integration on cognitive decline over the course of two years in Midwestern dwelling older adults. Connectivity was defined as the number of paths, streets, homes or businesses directly linked to an individual's home. Individuals living in remote rural areas would have lower connectivity scores than those living in suburban neighborhoods. Integration was used as a measure of how many turns or choice points a person was required to experience in order to access locations within a delimited system. Neighborhoods built on a grid system had higher scores than those with winding roads, one-way streets, and other convoluted pathways. Participants were asked to self-report weekly PA using a commonly used geriatric self-report scale. 39 cognitively normal older adults and 25 adults with early stage AD participated in the two-year study. A variety of validated cognitive tests were administered at baseline and at two years. Higher neighborhood integration was associated with lower rates of walking for individuals with mild AD. Older age was predictive of lower scores on cognitive

performance tests of attention and memory. Self-reported walking did not impact cognitive scores at baseline. Healthy adults living in neighborhoods with higher levels of integration experienced greater declines in both attention and verbal memory over the two -year study period. Higher baseline cognition was associated with fewer declines in all three cognitive domains. Older adults with mild AD living in highly integrated neighborhoods experienced greater declines in attention over two years. Self-reported walking among mild AD participants was not predictive of changes in cognitive performance. Overall, neighborhoods with greater connectivity (available potential walkable options) were associated with maintained cognitive function among healthy older adults.[55]

As mentioned previously, Vidoni and colleagues found a dose-response relationship between cardiovascular fitness levels and cognition.[17] The methodology of this study was unique in that incorporated a network of local community resources (YMCA facilities and staff) as the primary method of program delivery, thus increasing the real-world applicability of the findings. While this study utilized one form of community-based approach, participants were living in a metropolitan area, and it cannot be assumed that similar results would be found in rural populations with similar age and risk factors.

Researchers and health practitioners agree that the need for community-based exercise programs for older adults is great. And while a number of nationally recognized programs exist for older adults, few of these programs are available in rural communities nationwide. Additional barriers exist for rural communities to engage in community-based exercise classes as well. Qualified staffing, appropriate facilities and cost all pose barriers to rural program development and implementation. Addressing personal and cultural barriers is imperative to encourage

participation and compliance in such programs. Programs that incorporate a combination of education and education may provide a potential solution.

Paschoa and Ashton published findings from a community-based walking and chair exercise program in rural North Carolina in 2016.[56] 23 sedentary older women (aged 55-89 years) volunteered to participate in a community-based exercise program. Of these participants, 17 completed the study. The majority of women were African American (n=13), three were Caucasian and one female was Hispanic. Chronic conditions such as arthritis, high blood pressure and obesity were prevalent, but all had received physician's clearance. Participants completed 9 weeks of twice weekly exercise (walking + chair exercises for joint health) and discussion sessions at a local parks and recreation facility. Discussions were focused on the benefits of walking, PA and cardiovascular health. Open ended questionnaires were used to assess healthy lifestyle knowledge and a separate questionnaire was used to assess program satisfaction. In addition to these measures, physical functioning was assessed via distance covered in 12 to 20 minutes of walking, pre- and post-exercise heart rate (HR) and a self-report pain scale. While there are several limitations to this study, it is one of the few recent publications using exercise as an intervention measure in a rural setting. Both adjusted mean distance covered, and post-exercise HR increased significantly from week 1 to week 9 (3.0 laps vs. 3.67 laps respectively) (98.4 bpm at session 1 vs. 124.5 bpm at session 17). Participants reported enjoying the program and felt they accomplished goals and gained knowledge about the importance of PA and exercise.[56] The sample size in this particular study was relatively small and results may or may not apply to rural communities in other regions of the country. What the study does provide is recommendations for future rural education and exercise programs. Future studies should include a more robust education program, including detailed instruction and

assistance with personal goal setting, presentations from a registered dietician or nutritionist and program promotion should play a key role in the recruitment process.

In 2000, investigators at the University of South Carolina, Stanford School of Medicine and St. Louis University attempted to identify the unique determinants of leisure time PA in rural and urban dwelling older women.[11] Using a modified version of the Behavioral Risk Factor Surveillance Survey (BRFSS), the research team collected responses from over 1300 ethnically diverse older women in the Midwest, South, West and Northwest regions of the United States. Zip codes surveyed each contained a minimum of 20% minority females from a variety of ethnic minority groups: Native American, African America, American Indian/Alaskan Native, and Hispanic. The survey results presented significant differences between urban and rural determinants of leisure time PA in all four regions of the country. Rural women, especially those with lower education attainment, reported significantly less PA than urban women. Rural women of all education levels reported more personal barriers to PA as well. Common barriers reported by rural older women ranged from lack of streetlights, sidewalks, access to facilities and lack of participation of individuals living nearby to family responsibilities, fear of injury and unsafe environments. The top three barriers for rural women were caregiving responsibilities, lack of time and lack of energy, while urban women cited lack of time, lack of energy and being too tired as the top three barrier to PA. Advanced age, less social support and greater perceived barriers to PA were all independently associated with sedentary behavior in urban women. Rural associations with sedentary behavior were far more numerous than those of urban women. Older age, less education, not having enjoyable scenery, not seeing neighbors exercise, greater perceived barriers, less social support, African American race and American Indian/Alaskan Native race were all independently associated with sedentary behavior.[11]. The results from this

study may help investigators better understand psychological, social and environmental factors contributing to sedentary behavior among ethnically diverse rural populations. Providing education opportunities for these populations may be an effective public health tool to encourage participation in leisure time PA.

Findings from Chrisman et al.'s 2014 investigation of perceived correlates of physical activity in rural adults provides further insight into the attitudes of rural adults, specifically Midwestern rural adults.[57] Unlike Wilcox et al.'s population of interest,[11] rural Iowa is not ethnically diverse. The majority of the state of Iowa is non-Hispanic white (94%) and the proportion of males to females is almost equivalent (50.4% female). Iowa's demographics are similar those of the state of interest for the populations studied in this project. 407 adults living in two rural Iowa towns were surveyed to assess the perceived social and physical environment, neighborhood characteristics and barriers to participating in physical activity and exercise. Multiple regressions revealed several important associations between social and physical environmental factors and domains of physical activity. This work provided much needed insight into the interdisciplinary functioning of a socioecological model. Social, environmental and public policy factors were all associated with physical activity levels in some regard. Specifically, physical activity in sport and active living domains were positively associated with attitudes about public policies and environmental variables.[57] Understanding the relationship between these variables may help public policy professionals design and implement more effective policies aimed at improving the health of rural residents and communities in the Midwest. Similar to findings from Wilcox, sidewalk availability was found to be an important neighborhood characteristic associated with active living.[11,57] A lack of association was found between both social support and environmental aesthetics and physical activity.[57] Theses results

were surprising, given that previous work had found strong associations to physical activity among both variables.[11] As expected, age and BMI were inversely associated with physical activity and exercise. While social support was not directly associated with PA in rural Iowa, married individuals reported more PA than both single residents and those living with a partner.[57] Perhaps marriage in and of itself provides ample social support for older adults in rural Iowa to significantly impact PA levels.

Additional research is needed to further understand the unique barriers to physical activity and exercise faced by rural Midwestern older adults. Understanding the barriers and benefits of this population of elders will ensure more effective public policy and community program development and success. Public health professionals would be well advised to incorporate healthy lifestyle education into exercise intervention programs, as knowledge and attitudes toward PA and exercise have been found to affect participation and healthy lifestyle behaviors.[11,15,17,31,56,57]

The LEAP! Curriculum

In 2015, The University of Kansas Alzheimer's Disease Center (KU ADC) developed a curriculum aimed at reducing risk factors for AD in cognitively normal adults. This curriculum, called LEAP (Lifestyle Empowerment for Alzheimer's Prevention), includes weekly workshops, a textbook (the LEAP! Manual), numerous handouts and a variety of activities and lectures [13]. The curriculum utilizes current research to provide practical lifestyle strategies linked to AD risk reduction and is the first translational research program developed by a nationally recognized ADC. The program is unique in that its focus is prevention and is offered both in senior living communities and to the public at large. The Smart Aging manual is the book designed, written

and published by the KU ADC and used throughout each LEAP! workshop. Educational content is organized into chapters that highlight each of the six key lifestyle behaviors shown to promote brain health. A number of handouts and lectures were created to accompany each chapter and adequate time allocated for question and answer sessions with the professional(s) administering the workshop(s).

The original LEAP! curriculum was piloted at an affluent senior living community with highly educated residents in the Kansas City metropolitan area and received favorable reviews. Following this pilot program, the curriculum was revised to include information relevant to both community and independently living adults. For the purpose of this study, the curriculum has been revised further to include resources relevant to rural Kansas communities included in this study.

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The following manuscripts are written for submission to The Journal of Rural Health.

Promoting Physical Activity In Rural Kansas Through Education and Exercise Programs:

A Community-Based Intervention

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ABSTRACT

Context: Rural Americans (RA) report significantly higher percentages of obesity, chronic disease and cognitive decline than their urban counterparts; all conditions associated with inadequate physical activity, exercise and poor lifestyle behaviors. However, rural individuals face different barriers to physical activity and exercise than urban residents. **Purpose:** To increase physical activity among middle-aged and older adults living in rural Kansas through Alzheimer's disease risk-reduction education and community-based exercise interventions. **Methods:** Sixty-nine rural dwelling adults (17 male, 52 female; mean age 63.9 ± 7.95 years) participated in a 10-week community-based education and exercise intervention program in rural Kansas. Baseline physical fitness (Queen's College Step Test, blood pressure), balance and muscular endurance (30-second chair sit and stand), height, weight and girth measurements were assessed prior to participation. Subjects were randomly assigned to one of three groups and participated in either 10 weeks of Alzheimer's disease risk-reduction education (ED), education and exercise (EDEX) or were assigned to the control group (CON). Average weekly physical activity was assessed via wearable technology for all participants throughout the duration of the study. ANCOVAs with follow-up tests were conducted to assess change before and after interventions ($P < .05$). **Results:** There was a significant interaction effect for group by time on average daily steps, $p<.01$. Follow up test indicated that EDEX subjects acquired significantly more steps (10803.3 ± 295.9) than CON subjects (8130.4 ± 336.5), but not significantly more steps than ED subjects (9965.7 ± 292.5). There was a significant Time by Group interaction effect for Chair Test performance, $p < .01$. Follow up tests indicated that EDEX subjects performing significantly better (19.6 ± 2.7 repetitions) than CON subjects (16.4 ± 4.1) and better than ED

subjects (17.71±3.8), in the chair test following the 10-week intervention. Follow up tests also indicated that the ED subjects did not perform significantly better that the CON subjects on the chair test following the intervention. There was a main effect of time for weight, $p<.01$. However, analyses revealed a non-significant Time by Group interaction, $p=.06$. There was a main effect of time on waist to hip ratio, $p<.05$ with all groups improving after 10 weeks. Results also revealed a main effect for BMI, with BMI values decreasing over time. Time by Group interactions were non-significant, $p=.06$. **Conclusions:** AD risk-reduction education paired with regular, supervised exercise appeared to be effective at promoting increased physical activity levels and reducing fall risk in middle age and older adults. Supervised group exercise may help promote increased physical activity in middle age to older adults living in rural Midwestern communities.

Key words rural, cognitively normal, older adults

Introduction

Problems and Disparities in Rural America

Rural Americans are at a higher risk of developing a number of chronic diseases, including diseases of cognitive decline (e.g., Alzheimer's disease, dementia, Parkinson's disease), many of which are associated with lack of exercise and physical activity.[1,12,16] Alzheimer's disease affects over 5 million Americans and costs the United States nearly $400 billion annually. While some risk factors cannot be altered (age, sex, race), modifiable risk factors have been identified through extensive clinical research. [5-10,13,17,27,29,30,34-45] Several lifestyle behaviors have been identified as Alzheimer's disease (AD) risk reducing behaviors. These risk-reducing behaviors are physical activity and exercise, nutrition, social engagement, cognitive engagement, socialization, sleep and stress management.[13] Research suggests that individuals who regularly participate in these behaviors are at a lower risk of developing cognitive impairment than those who do not.[13] Of these six key behaviors, exercise appears to be among the most powerful tools for AD risk reduction. [5-10,13,17,27,29,30,34-45] Cardiovascular exercise such as walking, jogging, swimming, or cycling has been shown to be a powerful tool for reducing the risk of both chronic diseases and cognitive decline[3-10,17]. Cardiovascular exercise requires little equipment and could prove to be an extremely cost-effective means of preventing and potentially slowing down the progression of cognitive decline. Thus increasing physical activity (PA) levels among RAs is vital to reduce the prevalence of this incurable disease.

The health-related disparities that RAs face may be attributed to a number of factors, including unique barriers to physical activity and exercise, limited access to or knowledge of health resources, lower levels of education attainment, prevalence of obesity-related behaviors

and attitudes toward healthy lifestyle behaviors like exercise, physical activity and nutrition.[1,11,12,14,15,53]

Cultural norms and attitudes toward exercise may also be powerful determinants of physical activity and exercise.[15] Prior investigations have sought to understand the underlying culture among low-income rural populations as it applies to preventative health strategies.[15,31] Time, low priority, fear of the unknown, and lack of support have all been cited as perceived barriers to participation. When asked to identify incentives to participate, rural residents reported addressing health concerns, free services, engaging/enjoyable activities and free food as potential motivators.[31] This valuable feedback is necessary for public health officials, community health practitioners and investigators to design and implement successful health outreach programs in rural communities. Adults living in the rural Midwest seem to be unclear on the distinction between physical activity (PA) and exercise, often citing PA as more difficult than exercise.[15] Given that knowledge of physical activity and exercise appears to be severely lacking among rural Americans, significant attention should be paid to improving health literacy.

Limited access to resources play an important role in physical activity levels of individuals and populations as well. Rural populations tend to have more limited access to healthcare resources and health education.[11,15,31] While 17% of the United States population (59 million people) live in rural communities, only 9% of registered physicians practice in these areas, limiting access to high quality healthcare. Unfortunately, rural health priorities have remained relatively constant over the past decade. Access to healthcare services is still the primary health concern in rural communities. The next seven priorities are all directly related to risk factors associated with Alzheimer's disease.[51] The fact that these priorities have remained constant over the past decade reflect the lack of progress made in this sector. Significant

modifications to policies and health resources are necessary to bring rural communities up to date and reduce the disparities faced by this underserved population.

Despite the accumulating evidence for exercise as a protective therapy, physicians, academics and the public alike are reluctant to embrace exercise as preventative medicine.[34] Without organized community-based interventions, it is unlikely that RAs will increase participation in exercise and other preventative measures on their own.[11] This population is clearly disadvantaged and warrants significant effort into the development of programs that address the unique needs of rural communities. Obtaining the recommended amount of cardiovascular exercise may pose a greater challenge for individuals living in rural communities, as they are further from exercise facilities, and the presence of sidewalks is often limited.[1,16] Given that nearly 50% of all individuals are likely to experience some form of cognitive decline by age 85,[44] it is imperative that preventative measures be integrated into communities. For all of these reasons, it is necessary to investigate effective means of combatting the exceptional number of barriers and confounding risk factors RAs face.

Rural populations require such programs to be tailored to their specific needs. The purpose of this intervention was to determine if 10 weeks of community-based education and/or exercise could increase physical activity and reduce chronic disease risk factors among rural Kansas adults. The long-term goal of our work is to reduce the prevalence of cognitive decline in adults living in rural Kansas through community education and exercise interventions. We expected the 10-week intervention program would lead to significant improvements in a number of physical fitness parameters, and that combined education and supervised exercise would lead to the biggest changes.

Methods

Study Setting & Participants

Sixty-nine rural dwelling adults (17 male, 52 female; mean age 63.9±8.0 years) participated in a 10-week community-based education and exercise intervention program in rural Kansas. This study utilized a randomized controlled trial approach, consisting of 10 weeks of no intervention (CON), education only (ED), or education + facilitated group exercise (EDEX). We screened 93 individuals to achieve the desired enrollment goal of 75 healthy, cognitively normal older adult participants (age 50+). Participants were randomly assigned to one of the three study groups, creating a study ratio of 1:1:1. Individuals were selected to participate if they met the following criteria: healthy adult, free of chronic disease, free of diagnosed AD or dementia (cognitively normal), age 50+, no physical limitations preventing them from moderate intensity exercise, able to attend a minimum of 80% of the education and exercise sessions offered.

All study procedures took place at a centrally located facility in rural Kansas that provided space for both exercise and education sessions.

Interventions

Education Curriculum: In 2015, an educational curriculum was developed with the aim of reducing risk factors for AD in cognitively normal adults. The curriculum closely adhered to standard public health recommendations[33] and includes evidence-based information on a variety of lifestyle behaviors associated with brain health. Topics covered within the curriculum are detailed in Table 1.[13] This curriculum, called LEAP! (Lifestyle Empowerment for Alzheimer's Prevention), utilizes current research to provide practical lifestyle strategies linked to AD risk reduction. The curriculum materials include a LEAP manual, numerous handouts on AD, AD

risk-reduction strategies and healthy lifestyle behaviors, research highlights, PowerPoint presentations and interactive activities associated with each lifestyle behavior. The curriculum was piloted and revised based on input from cohorts at senior living communities and community forums in the surrounding metropolitan area.

Curriculum materials, most notably those referencing community resources, were modified to apply to the rural communities represented in this study. Specifically, information was added to the curriculum materials to highlight resources available within the region, such as parks, trails, nutrition resources, community programs, social events and others related to the curriculum material. Lecture, small group discussion and interactive activity formats were incorporated into each weekly workshop. These sessions provided background information on AD, AD risk, exercise and cognitive function, trends in rural Kansas/America, current research, exercise modalities and other related topics. Participants received a number of handouts and educational resources in addition to the LEAP Manual throughout the course of the study. For this project, the curriculum was organized into 8 chapters (Table 1) and included evidence-based information and recommendations on each of the modifiable lifestyle behaviors found to impact individual risk for AD. These material from these 8 chapters was taught over the course of 10 weeks.

Exercise Curriculum: The exercise curriculum was based on a combination of standard public health recommendations and previously published research.[17,29,33,35,36,39] Each exercise session included a 5-minute warm-up, cardiovascular exercise, resistance training exercises, and a 5-minute cool-down. Cardiovascular exercise was performed on one of the following: 160m indoor walking/jogging track, treadmill or elliptical trainer. Participants were trained to use a modified RPE scale to assess their intensity level. During the first week of training, participants

performed 60 minutes of cumulative cardiorespiratory exercise (20 minutes per session) and two sets of eight repetitions on a variety of resistance training exercises (strength exercises). Both cardiorespiratory and strength training components of the exercise sessions gradually increased in volume, peaking by week 8 with 108 minutes of cardiorespiratory exercise and three sets of ten repetitions on each strength exercise. Strength exercises incorporated into this program were those previously associated with cognitive function and/or brain volume.[23,24,36,39] Modifications were provided for all exercises and each participant was progressed as individual technique and fitness level allowed.

Treatment Groups

Education Group (E): Participants in the E group received a Garmin Vivofit 3 device, the LEAP manual, weekly group education sessions and were encouraged to increase physical activity levels. Education sessions were 70-90 minutes in duration and were taught by a member of the research team trained in health education and had 10+ years of teaching, program design and exercise coaching experience. While physical activity and exercise were encouraged, no in-person exercise training was provided. Information was provided throughout the education program on how to effectively increase physical activity levels and the resources available within the communities represented were highlighted. Physical activity tracking devices were synced each week during the education session to allow the research team to track physical activity levels of each participant.

Participants were required to attend at least 8 of the 10 educational sessions.

Education + Exercise Group (EDEX): EDEX participants participated in weekly group exercise in addition to attending the weekly education sessions. Exercise sessions for the EDEX group

were led by the research team member who was trained and had 10+ years experience in exercise program design and coaching. The exercise session leader was assisted by student interns who completed competency-based evaluations. EDEX participants were expected to exercise in a semi-group format three times each week. Personalized exercise logs were provided for each participant each week.

In order to accommodate the many schedules of participants, six exercise sessions were offered. Participants were allowed to exercise during any of the available, non-consecutive sessions, with a minimum of 24 hours between exercise bouts. Participants who planned to miss an exercise session(s) due to travel were provided with an exercise training document to use while out of town. EDEX participants were required to attend 8 of the 10 weeks of exercise sessions. Participants were informed that extended (>2 absences from education or >6 absences from exercise) would result in removal from the study.

Control Group (C)

Participants randomized to the CON group were given a physical activity tracking device (Garmin Vivofit 3), the LEAP! Manual and told to contact the principal investigator with any questions throughout the study period. Participants in this group were asked to meet a member of the research team every few weeks to sync their physical activity tracking device. While the LEAP! Manual contained information highlighting the importance of physical activity as it relates to brain health, no details were provided on how to improve physical activity levels or the resources available to the communities represented. Aside from baseline and post-intervention assessment and this interaction, CON participants did not participate in any additional study procedures and were encouraged to continue their normal daily activities. They were not asked to engage in any activity beyond what they were normally accustomed to.

Outcomes

The baseline evaluation consisted of the following outcome assessments: submaximal VO$_{2max}$ (Queen's College Step Test), 30 second Chair Stand Test, weekly physical activity/exercise, blood pressure, height, weight and girth measurements. Waist to hip ratio was calculated from girth measurements for all participants according to standard protocol. The Chair Stand Test not only measures muscular endurance but is a validated assessment of risk of falls. Upon completion of baseline evaluations, all participants were randomly assigned to one of three study groups.

Weekly physical activity data (as measured by daily steps) were collected through use of wrist-worn physical activity tracking devices. The device used for this study uses an accelerometer to capture physical movement and reports that movement as steps. This particular device assumes a generic daily goal of 10,000 steps and automatically adjusts that goal up and down according to each individual's actual daily step total. Thus, individuals moving less will have a lower step goal than those moving more throughout the average day. These devices do not use GPS or heart rate data. The device collects and stores physical activity, exercise and sleep data for 30 days. These devices sync to both smart phones via Bluetooth technology and to a computer via an ANT stick. Participants were assisted in syncing their device with their smart phone. Participants without access to a smart phone synced with their device weekly with a designated computer under the supervision of a research team member. Once a device had been synced, data was visible to both the participant and the research team the on Garmin Connect dashboard. We maintained record of all participants' physical activity data on a secured computer throughout the study period. Step data was recorded according to participant and analyzed by group.

Upon completion of the 10-week study, participants returned and performed all baseline assessments.

Data Analysis

Statistical analyses on all outcome measures was performed using SPSS software version 25. Data was inspected for skewness and kurtosis. Descriptive statistics provided a detailed analysis of the study population. Repeated measures ACNOVAs were used to evaluate differences and follow-up ANCOVAs were used to determine effect size and significant differences in each of the dependent variables. Gender, age and geographic proximity to town center all served as covariates for analyses. Associations were determined between study groups and cardiovascular fitness (estimated VO_{2max}), muscular endurance (30 second chair test), BMI, girth measurements, blood pressure and average weekly physical activity (as measured by average weekly steps). Step data for each participant (for each week) was included in analysis as long as a minimum of 3 days of reliable physical activity data were collected from the PA tracking devices. The validity and reliability of this minimum are supported by previous work.[59]

Results

Descriptives

Sixty-nine adults between the ages of 50 and 85 completed the 10-week study. The participant population was comprised of 24.6% males (n=17) and 75.4% females (n= 52). Average participant age was 63.9 (±8.0) years. 42% of participants were still working (n=29), while the remaining 58% were retired (n=40). All participants were residents of federally designated rural or frontier counties in the state of Kansas (50+ miles from the nearest metropolitan, population 50,000+). Twenty-seven lived in a country setting, outside of the

nearest city or town limits, placing them in the more geographically isolated areas of the Flint

Hills Kansas region. The remaining 43 lived within the city or town limits of various small

communities within the region (Table 2). The Flint Hills counties are characterized by ranching,

farming, and related rural-labor intensive industries. The county in which all study procedures

took place is consistently ranked among the most impoverished counties in the state of Kansas.[55]

The Flint Hills counties included in this study are known to have high rates of obesity, chronic

disease and disease of cognitive decline.[55] Participants had a mean BMI of 28.9±6.0 and mean

waist to hip ratio was 0.9±0.1. Twenty participants were classified as falling within a normal

weight range, 24 fell within the overweight category and the remaining 25 were categorized as

obese. Of the obese participants, 4 fell within the Class II obese category (very obese) and 4

were deemed extremely obese, having BMI values greater than 40.0. Over the course of 10

weeks, EDEX subjects accumulated, on average, well over 10,000 steps daily (10,803.3±295.9),

and ED subjects acquired nearly 10,000 steps daily (9965 .7±295.2), while CON subjects

accumulated just over 8,000 steps daily (8130.4±336.5), p<.05 (Figure 2).

Compliance

One (n=1) ED participant dropped out of the study due to inability to attend the minimum

number of education sessions. Five (n=5) participants were allocated to the intervention but

failed to attend pre-assessments and thus were unable to complete the study. The remaining 69

participants completed all required components of the study.

Physical Activity Index

Physical activity index was monitored via average daily steps achieved for each

participant (as captured via Garmin Vivofit 3 devices) and provided useable data for weeks 2

through 10. Week 1 data was inconsistent and may be attributed to participants adjusting to the use of new technology (physical activity tracking devices). After reminding several participants not to remove their device at any time, devices transmitted data with no problems. The wrist-worn physical activity tracking device used for this study uses an accelerometer to capture physical movement and reports that movement as steps. This particular device assumes a generic daily goal of 10,000 steps and automatically adjusts that goal up and down according to each individual's actual daily step total. Thus, individuals moving less will have a lower step goal than those moving more throughout the average day. These devices do not use GPS or heart rate data.

Repeated measures ANCOVAs revealed a significant group by time interaction, $F(2,26)=1.75$ $p=.001$. Eighty-five percent of the variance in average daily steps was explained by the group interactions. The physical activity index (average daily steps) throughout 10-week study period was found to be significantly different between groups, $p<.05$.

Queen's College Step Test

The Queen's College Step test proved to be challenging for many participants and resulted in unreliable estimated VO_2max data. While participants were given 3 step height options, it remained difficult for individuals to perform the test accurately. Participants struggled to step in time with the given metronome cadence, thus reducing the reliability of post-test heart rate. In addition, reliable conversions for VO_2max for this test performed at various step heights do not exist. For these reasons, cardiovascular fitness data was assessed as 15-second post-test heart rate (15sHR), as opposed to a calculated submaximal VO_2max value. Time by Group interactions were not significant.

Chair Test

There was a significant Time X Group interaction effect for Chair Test performance, $F_{(2,64)}=6.17$, $p=.004$. Follow up tests indicated that the EDEX group improved significantly more (19.6 ± 2.7) than the CON group (16.4 ± 4.1), following the 10-week intervention, $F_{(1,41)} = 10.9$, $p < .01$.The EDEX group also improved more so than the ED group (17.71 ± 3.8), $F_{(1,42)}=6.3$, $p<.05$ following the intervention (Table 3). It is worth noting that all groups achieved the minimum passing score for this test both before and after the intervention (12 repetitions moving safely from a seated position to a standing position and back).

Blood Pressure, Weight, Waist to Hip Ratio and BMI

No significant differences were found between or within groups for blood pressure ($p<.05$), although there was dramatic individual variability.

The Time by Group interaction for weight was not significant, $F_{(2,62)}=2.95$, $p=.059$, although it approached statistical significance.

There was no time by group interaction for any group for waist to hip ratio or BMI, $p<.05$, although the time by group interaction approached significance for BMI, $p=.059$.

Main Effects

ANCOVAs revealed a significant main effect for time for the Queen's College Step Test, $F_{(2,64)}=4.8$, $p=.033$. There was a main effect of time for weight, $F_{(2,64)}=13.92$, $p<.01$, with all groups tending to lose weight over the course of 10 weeks. While it appeared that the EDEX group lost more weight than the CON group, these results were not significant, $p<.05$. There was also significant Time by Gender interaction for weight, $F_{(2,64)}=5.09$, $p<.05$. There was a main effect of time on waist to hip ratio, $F_{(2,64)}=6.8$, $p=.012$, with all groups improving slightly in

this measure after 10 weeks. Subjects' girth measurements, and thus their waist-to-hip ratios, improved over time, M=0.94 (pre), M=0.92 (post), but did not differ significantly between any group. There was a main effect of time for BMI, $F(2,64)=10.5$, $p=.002$, and a nearly significant Time by Group interaction for BMI, $F(2,64)=3.0$, $p=.059$ (Table 3). BMI values tended to decrease between time 1 and time 2, $M = 29.0$ (pre), 28.6 (post). The time by gender interaction accounted for 7.4% of the variance for weight within the overall model. No other covariates significantly added to the model for any of the dependent variables, $p<.05$.

Discussion

Although there have been numerous investigations into the effectiveness of exercise interventions on improving physical fitness measures, few have examined such programs in rural settings. To the best of our knowledge, none have investigated the impact of Alzheimer's disease risk reduction education on physical activity levels and physical fitness outcomes. This study was an attempt to provide a culturally relevant program to an underserved, at-risk population in hopes of creating effective risk reducing behavior.

The findings revealed that the Education + Exercise group achieved better improvements in both physical activity levels and muscular endurance following the 10-week intervention relative to the other groups and nearly significant improvements in both BMI and weight loss. It is not surprising that EDEX participants achieved significantly higher scores on the chair test, as they had been participating in upper, lower and total body strengthening exercises thrice weekly for 10 weeks. Individuals in both the ED and EDEX groups achieved greater average daily steps throughout the study period than the typical rural adult (CON). Given the requirements of the intervention, it is perhaps not surprising that EDEX participants achieved higher levels of physical activity than the CON participants. However, it is interesting to note that the Education-

only group accumulated greater average daily steps throughout the study period than the CON

group and did not differ significantly from the EDEX group. These results are promising and

may possibly be attributed to the motivational climate and interactive style of the education

provided. This finding suggests that the education was effective in motivating positive behavior

change, resulting in increased physical activity among rural adults.

Recent data found that the average American achieves less than 6,000 steps daily and that

the majority of rural Americans achieve the recommended 150 minutes of physical activity

weekly.[32] This was not the case with the CON group in the current study. The average rural

Kansas adult (CON) accumulated between 7,000 and 8,000 steps daily. There are a number of

factors that may explain this variance. The recent study reporting low PA levels worldwide used

mobile device apps to record daily step counts.[32] The current study used wrist-worn physical

activity tracking devices. In addition to these two devices, there are a number of other commonly

used methodologies and various device brands, all of which use various algorithms and

modalities to collect physical activity data. The reliability of physical activity tracking devices is

of constant debate. As they continue to be used for data collection in research, establishing

reliability will be of upmost importance. Motivational factors may have played a role as well.

Control participants received the same physical activity tracking device as both ED and EDEX

participants. The fact that CON participants could view and track their physical activity levels if

desired may have led to physical activity levels that were higher than those previously published.

Further study is needed to draw stronger conclusions regarding physical activity outcome.

While changes in weight and BMI were not significant, they neared significance (p=.059)

in only 10 weeks, a relatively short period of time for an exercise intervention. Had the

intervention lasted 3-6 months, changes in BMI and weight may have indeed reached

significance. It is worth noting that a number of participants successfully reduced BMI values, moving them into a healthier weight classification. The majority of study participants began intervention with weight classifications deeming them overweight (n=24), obese (n=25). After 10 weeks, individual BMI values had improved dramatically, moving a number of individuals into healthier weight classification categories. Upon study completion, fewer participants fell within the overweight (n=22) and obese categories (n=18).

According to recent data, approximately 60% of residents within the study area have reasonable access to exercise facilities.[55] However, these facilities require a financial commitment, and given that the mean household income of the study population is nearly $14,000 less than the national mean,[55] it is not surprising that such a large percentage of these rural residents fail to utilize such resources. Statewide, the Kansas poverty rate for adults 65 years and older is reported at 7.4% (2011-2015 mean). Counties included within this study were as high as 9.2%, and the town in which all study procedures took place, and the majority of subjects reside, is reported at 12.4%.[55] It may not be surprising then that this population may see other financial concerns as higher priority than fitness memberships or consuming a whole foods-based diet. While a number of facilities and resources exist that offer programs focused on physical activity and senior health, counties represented in the study still report high rates of chronic disease, obesity and diseases of cognitive decline.

Rates of AD are as high as 10.3% in some counties in the study area, and obesity rates are well over 35%. This data was supported by our study population. 71% of the study population was determined to be overweight and 26% were classified as obese based on BMI values. Over 40% of residents residing in these counties have diagnosed high cholesterol and hypertension rates range from 30% to >40%.[55]   Further investigation is needed to address the factors limiting

utilization of available exercise and other health-related resources in the communities included within this study.

This study has limitations that warrant consideration. First, the study population, while sufficient in numbers, was drawn from one specific region of rural Kansas and was comprised of primarily Caucasian individuals. While this is representative of the geographic region in question, results from this study may not be directly applicable to more ethnically diverse rural communities. Further investigations are needed to understand more ethnically diverse populations in rural Midwestern communities. Second, physical activity data was collected via wearable technology, thus the research team relied on proper functioning of the devices utilized. Wearable technology has become increasingly popular in recent years and is thought to be an effective means of providing physical activity and exercise motivation and accountability.[56,57] Most devices store user data for weeks or months, and require minimal to no manual daily adjustments, making them much easier to use than traditional pedometers. For this reason, these devices are becoming much more frequently used in exercise and physical activity research.[56,58] The devices utilized in this study served as a motivational tool to encourage participants to increase daily physical activity levels. The results suggest that simply providing this motivational tool is not effective enough to result in increased physical activity levels in this population. In this case, education and/or supervised exercise were necessary to elicit physical activity improvements.

The relatively short study period may have limited the significance of some study measures. Longitudinal investigations are needed to gain a deeper understanding of exercise intervention outcomes and long-term exercise adherence following education and/or exercise interventions.

Finally, the cardiovascular fitness measure utilized in this investigation was determined to be invalid for the purposes of this study, and thus, conclusions cannot be drawn on the effectiveness of the exercise intervention on cardiovascular fitness levels. Ten weeks may have been an insufficient amount of time to elicit significant cardiovascular benefits using the given exercise format. Future investigations should consider alternative cardiovascular measures to better assess cardiovascular fitness of a wide range of fitness levels.

The results from this study support similar results from previous investigations that report positive results following exercise interventions.[21-23, 33,34,39,48,49] However, the unique contributions of this intervention are that (1) it utilized risk reduction education focused on brain health, coupled with exercise to promote increased physical activity and exercise and (2) it allowed education and exercise to be delivered in group and semi-group formats, as opposed to more traditional individual exercise sessions often used in clinical research. The group format may have provided camaraderie, as well as accountability, and may have contributed to the high compliance rates of participants.

AD risk reduction education has not been investigated to date as a means of improving physical fitness measures. AD is a progressive disease that has no cure. Pharmaceutical measures are available to treat symptoms, but not disease pathology.[3,7,9,13,44] This disease requires full-time caregiving, and thus not only imparts a burden on the affected individual, but also on the person providing care. The fear of losing one's independence due to cognitive decline may prove more powerful than the fear of developing a reversible or more easily remedied chronic diseases (e.g., hypertension, cardiovascular disease, type II diabetes). Until science can offer ways to alter this devastating disease, exercise may be the most powerful treatment available. The findings suggest that group education, paired with group exercise, is an effective tool for increasing brain health

awareness and instilling motivation to increase physical activity levels. Group education alone may also provide sufficient knowledge and motivation to increase physical activity levels, although the content and delivery modality of the education may play a significant role.Small group exercise appears to be effective in promoting physical activity among older rural adults, increasing muscular endurance, reducing risk of falls, increasing weight loss and thus improving BMI and waist to hip ratio. Further investigation is needed to determine whether group or individual exercise training leads to higher post-intervention exercise adherence and physical fitness outcomes.

To the best of our knowledge, this is the first study to use an AD brain health risk reduction curriculum to stimulate increased physical activity and/or exercise in rural America. This novel research is the first to investigate the physical fitness outcomes following community-based education and/or exercise in rural Kansas. Additional studies are needed in various geographic regions to determine unique disparities and variations between rural communities and ethnic groups.

While the benefits of exercise are well understood, health care professionals appear to be hesitant to prescribe exercise as an alternative means of chronic disease treatment and prevention. Exercise adherence rates, lack of education and exercise experience, patient attitudes toward exercise, lack of resources and a number of other concerns may all play a role in the insufficient use of exercise as medicine.[11,15,34] For these reasons and more, it is imperative that clinical research utilize public health interventions to address the needs of the growing population of older adults.

Conclusions

       Community-based education and exercise interventions may provide a means of addressing health disparities of specific aging populations in rural America. Older RAs require programs that address their unique geographic settings, education level, exercise experience and available resources. Community-based education, coupled with group exercise appears to be an effective method of delivering much needed risk reduction programming to this underserved population. Based on the findings of this study, individuals who participate in such programs gain valuable physical benefits in several physical fitness measures that are positively associated with improved brain health. Support for similar programs can expand opportunities for rural Kansans and lead to a reduction in health disparities among older rural adults.

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Figures and Tables

Week	Topic
Table 1. LEAP! Manual Contents	
Week	**Topic**
Week 1	Introduction & Chapter 1 - Introduction and Alzheimer's Basics
Week 2	Chapter 2: Part I - Sedentary Behavior
Week 3	Chapter 2: Part II – Physical Activity
Week 4	Chapter 3: Exercise
Week 5	Chapter 4: Part I – Nutrition
Week 6	Chapter 4: Part II – Nutrition
Week 7	Chapter 6: Part I - Social Engagement
Week 8	Chapter 6: Part II - Cognitive Engagement
Week 9	Chapter 7: Sleep
Week 10	Chapter 8: Grief, Depression and Stress Management

Table 2. Baseline characteristics of study participants.

Characteristics	
Age, mean (SD) yrs.	63.9 (8.0)
Female, No. (%)	52 (75.4)
Male, No. (%)	17 (24.6)
Height, mean (SD) in.	65.1 (6.9)
Weight, mean (SD) lbs.	178.8 (42.4)
Waist to hip ratio, mean (SD)	0.9 (0.1)
Systolic blood pressure	121.8 (15.3)
Diastolic blood pressure	78.0 (10.4)
Rural/country resident, No. (%)	27 (39.1)
Residing within rural town, No. (%)	43 (62.3)
Obesity classification, No. (%)	
Overweight	24 (34.8)
Class I Obese	25 (36.2)
Class II Obese	4 (5.8)
Race/ethnicity, No. (%)	
White	68 (98.6)
Hispanic	1 (1.4)
Black/African American	0 (0)
Other	0 (0)
Retired, No. (%)	40 (58.0)

Table 3. Participant chair test, weight, waist:hip and BMI values before and after 10-week intervention. Values are reported as mean (SD).

	Chair test pre	Chair test post	Weight pre	Weight post	Waist:hip pre	Waist:hip post	BMI pre	BMI post
CON	15.4 (3.5)	16.4 (4.1)	174.6 (32.7)	173.7 (32.5)	0.93 (.06)	0.91 (.06)	29.2 (6.6)	29.0 (6.5)
ED	15.7 (3.5)	17.7 (3.8)	173.2 (44.9)	171.9 (43.1)	0.95 (.07)	0.93 (.07)	28.3 (5.7)	28.1 (5.5)
EDEX	15.6 (2.8)	19.6 (2.7)	189.3 (48.2)	184.8 (46.4)	0.95 (.08)	0.93 (.07)	29.5 (5.9)	28.8 (5.8)
TOTAL	15.6 (3.2)	17.9 (3.8)	178.8 (42.4)	176.6 (40.1)	0.94 (.07)	0.92 (.07)	29.0 (6.0)	28.6 (5.9)

Increasing Alzheimer's Disease Knowledge In Rural Kansas Through Education and Exercise Programs: A Community-Based Intervention

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ABSTRACT

Context: Rural Americans (RA) report significantly higher percentages of obesity, chronic disease and cognitive decline than their urban counterparts; all conditions associated with inadequate physical activity, exercise and poor lifestyle behaviors. Knowledge of risk factors and disease progression may impact these health disparities. **Purpose:** To increase Alzheimer's disease knowledge, healthy lifestyles and quality of life among middle-aged and older adults living in rural Kansas through Alzheimer's disease risk-reduction education and community-based exercise interventions. **Methods:** Sixty-nine rural dwelling adults (17 male, 52 female; mean age 63.9 ± 7.95 years) participated in a 10-week community-based education and exercise intervention program in Emporia, Kansas. Baseline Alzheimer's disease knowledge (ADKS), a self-evaluated healthy lifestyle profile assessment (HPLPII) and quality of life (OPQOL) were assessed prior to participation. Subjects were randomly assigned to one of three groups and participated in either 10 weeks of Alzheimer's disease risk-reduction education (ED), education and exercise (EDEX) or were assigned to the control group (CON). Repeated measures ANCOVAs with follow-up tests were conducted to assess change before and after interventions ($p<.05$). **Results:** At follow-up, there was a main effect of time for ADKS score, $p<.001$ and a nearly significant Time by Group interaction, $p=.054$. ADKS scores tended to increase from baseline to post-intervention, $M=25.29 \pm 2.56$ (pre), $M=27.64 \pm 2.41$ (post). There was a significant Time by Group interaction on HPLPII scores, $p<.05$. The EDEX group scored higher on the HLPLII (96.5 ± 11.04) than both the CON group (90.09 ± 10.96) and ED group (91.29 ± 14.85) following the 10-week intervention, $p<.05$. CON and ED groups did not differ significantly, $p<.05$. There was a significant Time by Group interaction for the physical activity domain of the HLPLII (HLPLII-PA), $p<.01$, with the EDEX group scoring significantly higher (23.59 ± 4.97)

than the CON group (20.22±4.66) and the ED group (21.13±5.09) following the 10-week intervention, p<.01. There was also a significant Time by Group interaction, p<.01 for OPQOL. The CON group scored higher (66.35±15.95) than the ED group (57.54±11.73) following the 10-week intervention p<.001. The EDEX group did not differ significantly from the either the CON or ED groups, p<.05. Neither gender, nor rural residence significantly impacted the model for any of the assessments conducted. **Conclusions:** AD risk-reduction education paired with regular, supervised exercise appears to be effective at increasing self-evaluated healthy lifestyle behaviors, but not necessarily self-reported quality of life (OPQOL).

Key words rural, cognitively normal, older adults

Introduction

Alzheimer's Disease and Health Disparities in Rural America

There are currently 5.3 Americans diagnosed with Alzheimer's disease.[44] Rural Americans (RAs) experience higher rates of cognitive decline than older adults living in urban or metropolitan areas.[16] AD is a progressive disease that has no cure. Pharmaceutical measures are available to treat symptoms, but these measures do not treat the disease pathology.[3,7,9,13,44] AD requires full-time caregiving, and thus not only imparts a burden on the affected individual, but also on the caregiver(s) as well. While other diseases (e.g., hypertension, cardiovascular disease, type II diabetes) can be treated and often reversed through lifestyle modifications, pharmaceutical treatment and surgery, cognitive decline is irreversible, and eventually results in loss of independence. The fear of losing one's independence may prove more powerful than the thought of inevitable surgery or daily pharmaceutical treatment. Until science can offer ways to alter this devastating disease, risk reduction may be the most powerful tool available to the worried well.

Rural Americans (RAs) are also at a higher risk of developing a number of chronic diseases, most of which are associated with lack of exercise and physical activity.[1,12,16] The health disparities RAs face may be attributed to a combination of several factors; obesity-related lifestyle behaviors, lower educational attainment, unique barriers to physical activity and exercise, limited access to health resources and health education and cultural norms.[1,11,12,14,15,53] Several obesity-related lifestyle behaviors have been identified as risk factors for Alzheimer's disease (AD). In fact, it is well documented that conditions like insulin insensitivity are associated with higher AD risk.[3-10,13] Conversely, regular engagement in healthy lifestyle behaviors has been found to reduce chronic disease and dementia risk. These behaviors include physical activity, exercise, nutrition, social engagement, cognitive engagement, socialization,

sleep and stress management.[13] Research suggests that individuals who regularly practice these behaviors are at a lower risk of developing cognitive impairment than those who do not. Current research suggests that exercise and nutrition may play the most significant role in reducing AD risk. [5-10,13,17,27,29,30,34-45]

Health education seems to be lower among RAs, directly impacting the self-efficacy of RAs to engage in risk-reducing behaviors.[15] Knowledge of basic health terminology appears to be lacking among rural Midwest adults. This lack of knowledge may very well reduce health self-efficacy and/or health literacy and indirectly increase disease risk. Knowledge of disease specific risk factors is imperative when delivering risk-reducing public health programs. The ability of individuals and populations to identify and effectively utilize the health resources available is essential for a positive impact to be made. Thus, health education may play a vital role in reducing risk factors for a variety of diseases among underserved populations and those with higher prevalence of given diseases. Given that risk-reducing knowledge appears to be severely lacking among RAs, significant attention should be paid to improving health literacy, especially for dementia. For this reason, community-based dementia education should be a top priority among public health professionals. It is not only vital that healthcare professionals attain this education, but that community members at large are privy to this potentially live-altering information. Robust community health curricula aimed at risk-reducing lifestyle behaviors may very well have the ability to reduce the prevalence of dementia in communities, as well as a number of other deleterious ailments. Without organized community-based interventions and education, it is unlikely that RAs will increase participation in risk-reducing behaviors independently.[11]

Limited access to resources play an important role in healthy lifestyle behaviors of individuals and populations as well. Rural populations tend to have more limited access to healthcare resources.[11,15,31] Only 9% of registered physicians practice in RA, while 17% of the United States population live in these rural communities. This not only limits access to quality healthcare but increases wait times and distance required to travel to qualified medical professionals. The rural health priorities, as set forth by Rural Healthy People 2020, have seen little progress throughout the past decade. Access to healthcare services has remained the primary concern of this nationwide health initiative. As disease rates continue to climb in RA, access to the best physicians and medical treatment are imperative.[1,12,16] Risk factors associated with AD remain high priority as well, reflecting the lack of progress addressing cognitive decline among RAs in recent years.[51] Significant policy modifications and improved access to health resources are required to more effectively serve rural communities and reduce the disparities faced by this underserved population.

Cultural norms and attitudes toward lifestyle behaviors are powerful determinants of physical activity and exercise, as well as other healthy lifestyle behaviors linked to AD. Prior studies have reported time, lack of social support, low priority, fear of the unknown, and other pressing responsibilities as perceived barriers to exercise and physical activity.[11,12,14-16,31]

Financial priorities may differ for RAs, and addressing financial barriers has been cited as a potential incentive to participate in health education programs. Other incentives reported include engaging activities, providing food and addressing relevant health concerns.[11,31] This essential feedback may help mold public health programs that are needed to increase healthy lifestyle behaviors among RAs and better impact this underserved population. It is imperative

that such programs be designed in a way that reflects the unique needs and disparities of rural communities.

This demographic is clearly disadvantaged and requires health education programs that address the unique needs of rural individuals and communities. For these reasons, it is necessary to develop and implement high quality health education to combat barriers faced by RAs and promote healthy lifestyle behaviors in an attempt to reduce individuals' risk of AD and other debilitating diseases.

The population of older adults (65 years+) in the United States is growing faster than any other age group. It is estimated that by the year 2030, this population will have nearly doubled in size from 2009.[50] Given that nearly 50% of all individuals are likely to experience some form of cognitive decline by age 85,[44] it is vital that risk-reducing education be provided to those most at risk. AD risk reduction education has not been investigated to date as a means of promoting physical activity, healthy lifestyle behaviors and disease-specific knowledge. The purpose of this intervention was to determine if 10 weeks of community-based education and/or exercise could increase Alzheimer's disease knowledge, self-evaluated healthy lifestyle behaviors and quality of life, and thereby reduce chronic disease risk factors among rural Kansas adults. The long-term goal of this study is to reduce the prevalence of cognitive decline in adults living in rural Kansas through community education and exercise interventions. We expected the 10-week intervention program would lead to significant improvements in all assessment measures, and that combined education and exercise would lead to the greatest improvements in both assessments of quality of life and healthy lifestyle profiles.

Methods

Study Setting & Participants

Sixty-nine rural dwelling adults (17 male, 52 female; mean age 63.9±8.0 years) participated in a 10-week community-based education and exercise intervention program in Emporia, Kansas. This study utilized a randomized controlled trial approach, consisting of 10 weeks of no intervention (C), education only (E), or education + facilitated group exercise (EDEX). We screened 93 individuals to achieve the desired enrollment goal of 75 healthy, cognitively normal older adult participants (age 50+). Participants were randomly assigned to one of the three study groups using computerized randomization, creating a study ratio of 1:1:1. Individuals were selected to participate if they met the following criteria: healthy adult, free of chronic disease, free of diagnosed AD or dementia (cognitively normal), age 50+, no physical limitations preventing them from moderate intensity exercise, able to attend a minimum of 80% of the education and exercise sessions offered.

All study procedures took place in Emporia, Kansas at Emporia State University (ESU). Exercise sessions were held at the ESU Student Recreation Center and education sessions were held in a classroom located in the School of Education building.

Interventions

Education Curriculum: In 2015, The University of Kansas Alzheimer's Disease Center (KU ADC) developed a curriculum aimed at reducing risk factors for AD in cognitively normal adults, closely adhering to standard public health recommendations.[33] This curriculum, called LEAP! (Lifestyle Empowerment for Alzheimer's Prevention), utilizes current research to provide practical lifestyle strategies linked to AD risk reduction. The curriculum materials

include a LEAP manual, numerous handouts on AD, AD risk-reduction strategies and healthy

lifestyle behaviors, research highlights, PowerPoint presentations and interactive activities

associated with each lifestyle behavior. The curriculum was piloted and revised based on input

from cohorts at senior living communities and community forums in the Kansas City

metropolitan area.

Curriculum materials, most notably those referencing community resources, were

modified to apply to the rural communities represented in this study. Lecture, small group

discussion and interactive activity formats were incorporated into each weekly workshop. These

sessions provided background information on AD, AD risk, exercise and cognitive function,

trends in rural Kansas/America, current research, exercise modalities and other related topics.

Participants received a number of handouts and educational resources in addition to the LEAP

Manual throughout the course of the study. For this project, the curriculum was organized into 8

chapters (Manuscript 1, Table 1) and included evidence-based information and recommendations

on each of the modifiable lifestyle behaviors found to impact individual risk for AD. These

material from these 8 chapters was taught over the course of 10 weeks.

Exercise Curriculum: The exercise curriculum was based on a combination of standard

public health recommendations and previously published research.[17,29,33,35,36,39] Each exercise

session included a 5-minute warm-up, cardiovascular exercise, resistance training exercises, and

a 5-minute cool-down. Cardiovascular exercise was performed on one of the following: 160m

indoor walking/jogging track, treadmill or elliptical trainer. Participants were trained to use a

modified RPE scale to assess their intensity level. During the first week of training, participants

performed 60 minutes of cumulative cardiorespiratory exercise (20 minutes per session) and two

sets of eight repetitions on a variety of resistance training exercises (strength exercises). Both

cardiorespiratory and strength training components of the exercise sessions gradually increased in volume, peaking by week 8 with 108 minutes of cardiorespiratory exercise and three sets of ten repetitions on each strength exercise. Strength exercises incorporated into this program were those previously associated with cognitive function and/or brain volume.[23,24,36,39] Modifications were provided for all exercises and each participant was progressed as individual technique and fitness level allowed.

Treatment Groups

Education Group (E): Participants in the E group received a Garmin Vivofit 3 device, the LEAP Manual, weekly group education sessions and were encouraged to increase physical activity levels. Education sessions were 70-90 minutes in duration and were taught by a research team member who was trained in health education and had 10+ years of experience in higher education and exercise program design and coaching. Education sessions consisted of lecture, discussion and hands-on activities. The topics covered throughout the 10-week study period are outlined in Table 1. Educational materials included the LEAP! Manual, numerous handouts and worksheets, weekly out of class assignments and occasional samples or resources provided by local vendors specializing in products relevant to the course topics. While physical activity and exercise were encouraged, no in-person exercise training was provided. The LEAP! curriculum provides information emphasizing the importance of PA and exercise for brain health, and increasing participants were encouraged on a weekly basis to reach or surpass their own personal daily step goal. Physical activity tracking devices were synced each week during the education session to allow the research team to track physical activity levels of each participant.

Participants were required to attend at least 8 of the 10 educational sessions.

Education + Exercise Group (EDEX): EDEX participants participated in weekly group exercise in addition to attending the weekly education sessions. Exercise sessions for the EDEX group were led by the principal investigator and assisted by student interns who completed competency-based evaluations. EDEX participants were expected to exercise in a semi-group format three times each week. Personalized exercise logs were provided for each participant each week.

In order to accommodate the many schedules of participants, six exercise sessions were offered. Participants were allowed to exercise during any of the available, non-consecutive sessions, allowing a minimum of 24 hours between exercise bouts. Participants who planned to miss an exercise session(s) due to travel were provided with an exercise training document to use while out of town. EDEX participants were required to attend 8 of the 10 weeks of exercise sessions. Participants were informed that extended (>2 absences from education or >6 absences from exercise) would result in removal from the study.

Control Group (C)

Participants randomized to the CON group were given a physical activity tracking device (Garmin Vivofit 3), the LEAP! manual and told to contact the principal investigator with any questions throughout the study period. Participants in this group were asked to meet a member of the research team every few weeks to sync their physical activity tracking device. Aside from baseline and post-intervention assessment and this interaction, CON participants did not participate in any additional study procedures and were encouraged to continue their normal daily activities. They were not asked to engage in any activity beyond what they were normally accustomed to.

Outcomes

The baseline evaluation consisted of the following outcome assessments: the Alzheimer's disease knowledge scale (ADKS) as a measure of AD specific knowledge, modified Healthy lifestyle profile assessment (HLPLII), a self-reported measure of perceived health in a number of dimensions (physical, emotional, psychological, environmental, and so on), the older person's quality of life assessment (OPQOL), a measure of overall perceived quality of life. Physical activity, as measured by average daily steps, blood pressure, height, weight and girth measurements were also obtained. Waist to hip ratio and BMI were calculated from height and girth measurements for all participants according to standard protocol. Upon completion of baseline evaluations, all participants were randomly assigned via computerized randomization to one of three study groups.

Physical activity data (as measured by daily steps) was collected through use of waterproof wrist-worn physical activity tracking devices with a one-year battery. The device used employs a simple accelerometer to collect and store physical activity, exercise and sleep data for 30 days. The device syncs to both smart phones via Bluetooth technology and to computers via an ANT stick and online data portal. Participants were assisted in syncing their device with their smart phone. Participants without access to a smart phone synced with their device weekly with a designated computer under the supervision of a research team member. Once a device had been synced, data was visible to both the participant and the research team an online, HIPPA compliant dashboard. A record of all participants' physical activity data was kept on a secured computer throughout the study period. Physical activity data (average daily steps) was recorded according to participant and analyzed by group.

Upon completion of the 10-week study, participants returned and performed all baseline assessments.

Data Analysis

Statistical analyses on all outcome measures was performed using SPSS software version 25. Skewness and kurtosis analyses were performed on all data. Data was found to be normally distributed. Descriptive statistics provided a detailed analysis of the study population. Repeated measures ANCOVAs to evaluate differences and follow-up ANCOVAs were used to determine significant differences, if any, in each of the dependent variables. Gender, age and geographic proximity to town center all served as covariates for analyses. Associations were determined between study groups and ADKS (AD knowledge), HLPLII (healthy lifestyle profiles) and OPQOL (quality of life).

Results

Descriptives

Sixty-nine adults between the ages of 50 and 85 completed the 10-week study. The participant population was comprised of 24.6% males (n=17) and 75.4% females (n= 52). Average participant age was 63.9 (±8.0) years. 42% of participants were still working (n=29), while the remaining 58% were retired (n=40). All participants were residents of federally designated rural or frontier counties in the state of Kansas (50+ mile from closest metropolitan area, population 50,000+). Twenty-seven participants resided in a country setting, outside of the rural town limits, placing them in the more geographically isolated areas of the region. The remaining 43 lived within the town limits of various communities in the region (Table 1). The counties included within this study are characterized by ranching, farming and related rural

industries. The county in which all study procedures took place is consistently ranked among the most impoverished counties in the state of Kansas. The counties included in this study are known to have high rates of obesity, chronic disease and dementia.[55] Participants had a mean BMI of 28.9±6.0 and mean waist to hip ratio was 0.9±0.1. Twenty participants were classified as falling within a normal weight range, 24 fell within the overweight category and the remaining 25 were categorized as obese. Of the obese participants, 4 fell within the Class II obese category (very obese) and 4 were deemed extremely obese, having BMI values greater than 40.0 (Table 1). Over the course of the study period, EDEX subjects acquired an average of 10,803.3 (±295.9) steps daily. ED subjects acquired a similar amount of physical activity (9965 .7±295.2 steps daily), while CON subjects acquired just over 8,000 steps daily (8130.4±336.5).

Compliance

One (n=1) ED participant dropped out of the study due to inability to attend the minimum number of education sessions. Five (n=5) participants were allocated to the intervention but failed to attend pre-assessments and thus were unable to complete the study. The remaining 69 participants completed all required components of the study, resulting in exemplary participant retention.

Alzheimer's Disease Knowledge

There was a nearly significant Time by Group interaction, $F(2,64)=3.07$, $p=.054$. ADKS scores increased from baseline to post-intervention, $M=25.29±2.56$ (pre), $M=27.64±2.41$ (post), but did not appear to differ significantly between groups, $p<.05$.

Healthy Lifestyle Profile

The HLPLII assess self-perceived health in a number of domains, including but not limited to physical activity, psychological health, social health and environmental health among other domains. There was a significant Time by Group interaction, $F(2,64)=3.40$, $p<.05$. Follow up tests revealed a significant difference between CON and EDEX groups, $F(1,41)=4.53$, $p<.05$, with the EDEX group scoring higher (96.5 ± 11.04) than the CON group (90.09 ± 10.96) following the 10-week intervention. ED and EDEX groups also differed significantly following the 10-week intervention, $F(1,42)=4.27$, $p<.05$, with the EDEX group scoring higher (96.5 ± 11.04) than the ED group (91.29 ± 14.85) (Table 2). CON and ED groups did not differ significantly, $p<.05$.

HLPLII-Physical Activity (HLPLII-PA) represents self-evaluated assessment of healthy lifestyle behaviors that relate only to physical activity. Example questions from this section of the HLPLII provided in the appendix. There was also a significant Time by Group interaction, $F(2,64)=7.06$, $p<.01$. Follow up tests revealed significant differences between the EDEX and CON groups, as well as EDEX and ED groups. The EDEX group scored significantly higher (23.59 ± 4.97) than the CON group (20.22 ± 4.66), $p<.01$ and the ED group (21.13 ± 5.09) following the 10-week intervention, $p<.01$ (Table 2).

Quality of Life

There was a significant Time by Group interaction for OPQOL scores, $F(2,64)=5.49$, $p<.01$. Follow up tests revealed a significant difference between CON and ED groups, $F(1,43)=14.52$, $p<.001$, with the CON group scoring higher (66.35 ± 15.95) than the ED group (57.54 ± 11.73) following the 10-week intervention (Figure 6). The EDEX group did not differ significantly from the either the CON or ED groups, $p<.05$.

Main Effects and Covariates

There was a main effect on dementia knowledge (ADKS score), $F_{(1,64)}=13.69$, $p<.001$, with all groups tending to improve over time.

There was a significant main effect of time on HLPLII, $F_{(1,64)}=4.44$, $p<.05$. HLPLII scores tended to improve over time for all groups. There was also a significant main effect of time for HLPLII-PA, $F_{(2,64)}=5.88$, $p<.05$, with scores tending to improve over time for all groups.

Neither gender, nor rural residence nor age significantly impacted the model for any outcome variable (ADKS, HLPLII, OPQOL), $p<.05$.

Discussion

Although numerous investigations have been conducted to determine the impact of education on a variety of health parameters, few focus such programs in rural settings. To the best of our knowledge, none have investigated the impact of AD risk reduction education on Alzheimer's disease knowledge and related lifestyle behaviors. This study was an attempt to provide a culturally relevant program to an underserved, at-risk population in hopes of increasing knowledge of a specific disease and creating effective risk reducing behavior.

The findings revealed that the EDEX group scored higher on both HLPLII and HLPLII-Physical Activity assessments than both ED and CON groups. It was not necessarily surprising that EDEX group achieved significantly higher HLPLII scores than the ED and CON groups after 10 weeks of education. ED and EDEX participants received 10 weeks of education that was identical in both content and delivery. While CON participants received the same educational text as both ED and EDEX groups, they received no in-person education, opportunities for discussion, or homework assignments that would have reinforced the material in the text. In

addition, the EDEX participants participated in multiple sessions of weekly exercise, thus resulting in mandatory opportunities to practice healthy lifestyle behaviors (physical activity/exercise, social engagement, stress management). The EDEX group scored higher on self-evaluated healthy lifestyle profile assessment, both overall (HLPLII) and as it related to physical activity (HLPLII-Physical Activity). It is not surprising then, that this group reported greater healthy lifestyle behaviors, both overall, and specific to physical activity. These results support our hypothesis and thus are in line with the expectations of the study protocol.

This intervention did not result in improvements in elf-reported quality of life as expected. CON participants actually increased OPQOL scores relative to the ED group. This result was unexpected and may be explained in one of two ways. First, it this finding might be attributed to the nature of the assessment. While questions on the HLPLII are very short and straightforward, some questions on the OPQOL warrant further explanation and may be open to interpretation of the individual. The OPQOL contains 6 pages of questions, some of which are vague and/or caused confusion among participants. For example, one OPQOL question asks the reader to agree or disagree with the following statement: "I have my children nearby me, which is important." Questions of this nature may be interpreted in several different ways and may not pertain to all individuals. Perhaps it is not important to all adults that their children live nearby, while others may not have children at all. Regardless, this question and others proved difficult for many participants to effectively answer and may have skewed the results of this assessment. In the future, alternative quality of life assessments should be evaluated as potential replacements for this measure. On the other hand, while ED and EDEX participants received education informing them of all the ways in which they might choose to improve their overall health and reduce AD risk, CON participants did not receive this education. Thus, CON participants may

have simply been naïve to the fact that their lifestyle behaviors might indeed by lacking in some fashion. This might result in uncharacteristically high scores when compared with the newly enlightened ED and EDEX participants.

The state of Kansas is a good representative test bed for community health research in the rural Midwest as it is similar in geography, population, demographic make-up and socioeconomic status to the surrounding states in the region. Overall obesity rates for adults living within the county under question are currently estimated at 35%, which is consistent with the study population (36%). Rates of AD in the counties represented in the current study are high as 10.3%, nearly 3% higher than the state average.[55] These statistics, coupled with low education attainment rates within this area (22% of adults have a bachelor's degree or higher) may help explain the higher prevalence of dementia and obesity-related disease. Another confounding variable that warrants consideration is the economic climate of the region. Only 7.4% of older adults (65+) in Kansas live below the poverty line, counties represented in the current study ranged from 9.2-12.4%. While a number of exercise and recreation facilities are available to residents of these counties, financial barriers may prevent residents from taking advantage of the available resources.

The vast majority of study participants were Caucasian (n=68), which is representative of the region in which the study took place, but may not apply to all Kansas or rural populations. Most of Kansas (76.3%) remains heavily populated by Caucasian individuals. However, some western Kansas counties are comprised of more diverse populations, primarily dominated by Hispanic individuals.[55] In addition, the demographics of rural Midwestern communities may differ significantly from those in the Western states and/or Southern states. Cultural differences would need to be considered if administering the current study protocol in rural communities

nationwide. Further investigations are needed to understand more ethnically diverse populations in rural communities throughout the Midwest and beyond.

Wearable technology is thought to be an effective means of providing physical activity and exercise motivation and accountability and has become increasingly popular in recent years.[56,57] Most devices store user data for weeks or months, and require minimal to no manual daily adjustments, making them much easier to use than traditional pedometers. For this reason, these devices are becoming much more frequently used in exercise and physical activity research.[56-58] For the purposes of this study, physical activity data was collected via wearable technology, requiring the research team to rely on devices functioning properly and participants adhering to PA tracker instructions (e.g., "Do not remove your device at any time."). Occasionally, devices failed and required replacement. Extra devices were purchased ahead of time to account for such issues, making device replacement a relatively easy process. However, the reliability of PA tracking devices and the variability between different brands and models has yet to be equivocally determined. The reliability and validity of using such devices for hard data analysis is warranted in future research.

While 10 weeks was sufficient to increase AD knowledge and HLPLII scores, alternative study durations should be investigated in order to most effectively transition the study protocol to real world situations. Online education, coupled with in-person exercise training should be investigated as a means of program delivery. Longitudinal studies are needed to assess long-term retention of the education and adherence to lifestyle behaviors. Alternative exercise delivery methods warrant investigations as well.

Numerous previous investigations have reported the positive effects on physical health following exercise interventions.[21-23, 33,34,39,48,49] To the best of our knowledge, none have used

exercise and education combined to promote increased disease-specific knowledge and promote healthy lifestyle behavior change. The unique contributions of this intervention are that (1) it utilized risk reduction education focused on brain health, coupled with exercise to promote healthy lifestyle behaviors and increased awareness and (2) it delivered both education and exercise in group (education) and semi-group (exercise) formats, as opposed to more traditional individual exercise sessions often used in clinical research. The group format may have provided accountability, camaraderie, contributed to the high compliance rates of participants and potentially encouraged enhanced review and sharing of knowledge. Allowing ED and EDEX participants to engage in education sessions together allowed for personal interactions and peer-teaching opportunities. Participants often shared personal experiences, struggles and victories both in small groups and within the larger class as a whole. This social support, as supported by previous studies, may have played a significant role in education attainment and retention and accountability.[11,59-63]

The findings suggest that group education, paired with group exercise, is an effective tool for increasing brain health awareness and instilling motivation to increase physical activity levels. Supervised exercise and education appears to be effective in promoting physical activity among older rural adults, increasing self-evaluation of healthy lifestyle behaviors and knowledge and understanding of Alzheimer's disease and the associated risk factors. Further investigation is needed to determine whether group or individual exercise training leads to higher post-intervention exercise adherence and whether online or in-person education result in greater knowledge and lifestyle behavior practices. Additional delivery methodologies and durations should be investigated to determine the most effective combination of exercise and education.

While the benefits of exercise are well-documented, health care professionals seem hesitant to prescribe exercise as an alternative mode treatment and prevention. Patient and physician attitudes toward exercise, physician and/or patient exercise knowledge and experience, low adherence rates, lack of resources and a number of other concerns may all play a role in the insufficient use of exercise as medicine.[11,15,34,60-63] Social support, public policy, built environment and intrapersonal factors must all be taken into account when designing and implementing effective public health programs.[60] In many cases, education may prove to be the missing link in exercise interventions. While physical resources, policy and social support may be available to individuals, an understanding of health risk factors and the perceived and actual benefits to participation may be lacking, especially among underserved populations, like older rural adults. By increasing knowledge of risks and benefits, health professionals may be able to successfully increase participation in and adherence to exercise and other risk-reducing behaviors.

Conclusions

The older adult population is growing faster than any other age group in the United States. It is estimated that by the year 3030, nearly 80 million adults over the age of 65 will reside within the U.S., nearly doubling the population of this demographic since 2009.[50] Given that age is the primary risk factor for cognitive decline (AD),[44] healthcare professionals and public health officials have the responsibility to address the needs and risk factors of this growing population. Community-based education and exercise interventions may provide a means of addressing health disparities of specific aging populations. Older RAs require programs that address their unique geographic settings, education level, exercise experience and available resources.

AD risk-reduction education, coupled with group exercise appears to be an effective method of delivering much needed risk reduction education to this disadvantaged population. Based on the findings of this study, individuals who participate in such programs gain valuable benefits that promote both physical activity, as well as other healthy lifestyle behaviors. Support for similar programs can expand opportunities for rural Kansans and lead to a reduction in health disparities and ultimately reduce the prevalence of cognitive decline among older rural adults.

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Figures and Graphs

Table 1. Baseline characteristics of study participants.	
Characteristics	
Age, mean (SD) yrs.	63.9 (8.0)
Female, No. (%)	52 (75.4)
Male, No. (%)	17 (24.6)
Height, mean (SD) in.	65.1 (6.9)
Weight, mean (SD) lbs.	178.8 (42.4)
Waist to hip ratio, mean (SD)	0.9 (0.1)
Systolic blood pressure	121.8 (15.3)
Diastolic blood pressure	78.0 (10.4)
Rural/country resident, No. (%)	27 (39.1)
Residing within rural town, No. (%)	43 (62.3)
Obesity classification, No. (%)	
Overweight	24 (34.8)
Class I Obese	25 (36.2)
Class II Obese	4 (5.8)
Race/ethnicity, No. (%)	
White	68 (98.6)
Hispanic	1 (1.4)
Black/African American	0 (0)
Other	0 (0)
Retired, No. (%)	40 (58.0)

Table 2. Participant assessment scores before and after 10-week intervention. Values are reported as mean score (SD).

	ADKS pre	ADKS post	HLPLII pre	HLPLII post	HLPLII-PA pre	HLPLII-PA post	OPQOL pre	OPQOL post
CON	25.0 (2.9)	26.4 (2.3)	83.2 (12.3)	90.1 (11.0)	18.2 (5.1)	20.2 (4.7)	65.5 (14.3)	66.3 (16.0)
ED	25.0 (2.7)	28.0 (2.7)	84.7 (14.5)	91.3 (14.9)	18.7 (6.0)	21.1 (5.1)	62.8 (12.1)	57.5 (11.7)
EDEX	25.9 (1.9)	28.5 (1.6)	84.5 (11.6)	96.5 (11.0)	18.2 (5.0)	23.6 (3.8)	67.0 (12.6)	64.4 (9.1)
TOTAL	25.3 (2.6)	27.6 (2.4)	84.1 (12.7)	92.6 (12.6)	20.1 (5.3)	21.6 (4.7)	65.0 (12.9)	62.7 (13.0)

Perceptions and Attitudes Toward Exercise in Rural Kansas

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Abstract

Context: Rural Americans (RAs) are at a higher risk of developing a number of chronic diseases, many of which are associated with lack of exercise and physical activity. RAs may face unique barriers to exercise and physical activity than their urban counterparts. Investigation is needed to develop a better understanding of the barriers RAs face and the cultural, geographic and other determinants associated with these barriers. **Purpose:** To identify the perceived barriers to exercise and PA of rural Kansas adults and determine knowledge, or lack thereof, of basic health terminology. **Methods:** Participants from an existing study were asked to participate in open-ended interviews. Response frequencies to interview questions were determined and ANOVAs with follow-up tests were conducted to assess associations and differences, if any, between groups, genders, geographic proximity to town, retirement status and age ($p<.05$). **Results:** Participant responses regarding the benefits of exercise did not differ between study groups, $p<.05$. The most commonly reported benefits of exercise were brain health (n=14), improved overall health (n=13) and feeling better (n=11). Time, lack of motivation and injury/illness were reported as the most prevalent barriers to exercise overall. All participants acknowledged opportunities for exercise and physical activity within their community. Walking (n=8) and gym memberships (n=7) were the most commonly reported exercise opportunities. **Conclusions:** Rural Kansas adults acknowledge many benefits to participating in exercise and/or PA. However, obesity and chronic disease rates remain high. Time, lack of motivation and injury/illness were reported as the most prevalent barriers to exercise. Geographic proximity to town, gender, age and access to healthy lifestyle education all appear to be factors associated with perceived barriers to physical activity and exercise.

Key words rural, older adults, barriers, benefits, exercise, physical activity

Introduction

Health Trends and Inequities in Rural America

Rural Americans (RAs) are at a higher risk of developing a number of chronic diseases, many of which are associated with lack of exercise and physical activity.[1-6] Several factors contribute to health disparities RAs face, including higher obesity rates and obesity-related lifestyle behaviors, unique barriers to physical activity (PA) and exercise, limited access to healthcare and health resources, inadequate health literacy and cultural norms among others.[1-8,10-19] Lack of physical activity and exercise have been identified as risk factors for a number of chronic diseases ranging from type II diabetes to diseases of cognitive decline.[10,20,36-47,52,54,56,58,59,62,64] Alternatively, participating in regular physical activity and exercise, even activities as simple as moderate-intensity walking, have been shown to effectively improve a number of physiological functions, reduce disease risk and improve quality of life.[23-39,43-47,49,52,54-65]

Unfortunately, few individuals meet the recommended physical activity and exercise guidelines set forth by national governing bodies.[19,21,22] Research suggests that less than 50% of adults worldwide achieve the recommended 150 minutes of weekly physical activity/exercise.[21,22] Americans acquire fewer than 5,000 steps daily on average; less than half the arbitrary 10,000 steps per day recommendation.[20] Increased age, gender and increased BMI are all associated with lower levels of PA. Given that RAs tend to be older and more obese (higher BMI values), it is not surprising that RAs report less physical activity than their urban counterparts.[1,2,4-7,10]

Various factors influence attitudes toward and participation in physical health behaviors such as physical activity and exercise. Cultural norms, social support, available resources and

existing policies are all powerful determinants of physical activity and exercise.[2,4,5,7,11-17,19] Previous studies have found time, lack of social support, low priority, fear of the unknown, and other pressing responsibilities all to be perceived barriers to PA specific to RAs.[2,7,11-13,17]

Attainment of health education (and education in general) is lower among RAs, directly impacting the exercise self-efficacy of RAs. Knowledge of basic health terminology appears to be lacking among rural Midwest adults.[12] This lack of knowledge may very well reduce health self-efficacy and/or health literacy and be intimately linked to the high prevalence of obesity and chronic disease experienced by RAs. Knowledge of disease specific risk factors is imperative when delivering risk-reducing public health programs. The ability of individuals and populations to understand and apply basic health knowledge is essential for behavior change to occur.[17] Thus, it is imperative that health education and healthy literacy be assessed on a regular basis in rural communities. Increased health literacy may play a vital role in reducing risk factors for a variety of diseases among underserved populations and those with higher prevalence of obesity-related ailments.

Limited access to healthcare resources pose a significant barrier to healthy lifestyle behaviors of RAs and rural populations as well. Rural populations tend to have limited access to healthcare resources and health education, negatively impacting both health education and health literacy.[1,2,5,7,10-12] While nearly 25% of the United States population resides in rural America, less than 10% of registered physicians practice in these communities. This not only limits access to quality healthcare, but may result in insufficient health literacy and reduced utilization of the limited resources that are available to these populations. The priorities of Rural Healthy People 2020 have seen little progress over the past decade. Access to adequate healthcare remains the primary target nationwide for RAs. As disease rates continue to climb in RA, addressing limited

access to physicians, medical treatment and health education is key.[2,5,10] Significant modifications to the current structure of rural healthcare are necessary to address the consistent shortcomings of this sector in RA and better serve this at-risk population.

Rural health trends in Kansas are consistent with those nationwide. Poverty rates are higher in many rural Kansas counties than both the Kansas state and national averages.[4] While a number of facilities and resources exist that offer programs focused on health and senior health, counties represented in the study still report high rates of chronic disease, obesity and diseases of cognitive decline.[4] The mean household income is well below the state and national averages, which may contribute to reduced utilization of available PA and exercise facilities.[4] Thus, financial constraints may be a primary barrier for this population. Investigation is needed in order to support this hypothesis.

Addressing the barriers specific to RAs should be a primary target for public health professionals. Successful public health interventions cannot be delivered without first developing a deeper understanding of the intrapersonal and cultural values of these unique populations. RAs are at increased risk and thus deserve significant attention from community health investigators, healthcare professionals and individuals responsible for creating public health policy.

The purpose of this study was to (1) identify barriers to exercise and physical activity among rural Kansas adults, and (2) develop a better understanding of the views and attitudes toward exercise and physical activity among rural Kansas adults. We expected that barriers to exercise and PA and knowledge of basic health terminology would be similar to those previously reported in other Midwestern and low-income rural communities.[1,2,7,11-13]

Methods

Study Setting & Participants

Participants were recruited from an existing study population to participate in small group interviews in hopes of determining attitudes and views on exercise and physical activity among rural Kansas adults. The existing study consisted of 69 rural dwelling adults (17 male, 52 female; mean age 63.9±8.0 years) who were participating in a 10-week community-based education and exercise intervention program in Emporia, Kansas. This study utilized a randomized controlled trial approach, consisting of 10 weeks of no intervention (CON), education only (ED), or education + facilitated group exercise (EDEX). Participants assigned to the ED and EDEX groups received 10 weeks (once weekly) of education on healthy lifestyle behaviors as they relate to reducing individual risk for cognitive decline and other chronic diseases (LEAP!, or Lifestyle Empowerment for Alzheimer's Prevention).[47] EDEX participants also received supervised semi-group exercise 3 days weekly in addition to the weekly education. CON subjects received no in-person education or exercise. Details of this existing study are documented in the appendices.

All subjects participating in the existing study were asked to participate in the interviews via telephone and email. Multiple interview sessions were held on various dates and times to accommodate participant schedules. Of the 69 adults recruited, 23 (8 male, 15 female; mean age 61.09±7.60 years) consented to participate in the interviews. Interview sessions took place throughout the duration of the previously mentioned randomized controlled trial and continued until all interested participants had been given a chance to complete an interview. The first interviews took place after those assigned to the ED and EDEX groups had completed half (50%) of the educational curriculum. By this time, participants from the ED and EDEX group

have received information on physical activity, exercise, nutrition and an introduction to

Alzheimer's disease risk reducing behaviors.

Interviews

Interviews were conducted in small group settings, with no more than 4 participants at

any one interview session. Participants were provided with a typed copy of the interview

questions and asked to write their answers to each question as best they could. Individuals were

instructed to complete each question to the best of their knowledge, without the assistance of

other participants in attendance. Questions from the interview document included: "In your own

words, describe the difference between physical activity and exercise.", "What are the benefits of

exercise?", "Do you feel there are opportunities available to you to participate in exercise?" and

"What barriers prevent you from participating in exercise?" The complete interview document is

provided in the appendices. Clarification was provided for each question by the principal

investigator upon request. Participants were not provided with any additional assistance

completing the questions. Upon completion of the written interview, written answers were

collected, and participants were free to share their answers and additional thoughts with each

other and the research team if desired.

Analysis

Interview responses were read thoroughly by the principal investigator to determine

response themes. Relevant themes and issues from within and across groups were summarized. 5

categories were established for statistical analysis: benefits of exercise and physical activity,

barriers to exercise, barriers to physical activity, opportunities for exercise and physical activity,

and definitions of physical activity and exercise. Response themes and frequencies from those

categories were determined by tallying participant responses to each question. For example,

when asked about benefits of exercise and physical activity, participant responses included improved overall health, reduced stress and reduced disease risk, among others. After the principal investigator had tallied responses for each participant, a rigorously trained intern followed the same procedure, without use of the previously tallied results to ensure data accuracy. Tallied response data was compared and analyzed to determine frequency of responses to each question and significant differences, if any, between participant groups and characteristics. Participant responses and frequencies are discussed in detail in the results section.

Statistical analyses on all interview questions was performed using SPSS software version 25. Descriptive statistics provided a detailed analysis of the study population. One-way ANOVAs were used to determine significant difference, if any, between responses based on study group, gender, age, geographic proximity to town center and retirement status. Country residents were defined as those individuals living at least 1 mile outside of the nearest rural town limits. Associations were determined between all variables and all interview questions.

Results

Description of the Study Population

Participant characteristics are provided in Table 1. 23 Eight males and 15 females (mean age 61.09±7.60 years) agreed to participate in the interviews. Approximately half of the interview participants were retired (N=12) and all were of Caucasian ethnicity. While all participants lived within a federally designated rural county, 17 lived within the town limits and 6 lived in a country setting (minimum of 1 mile outside of town limits). Nine (9) participants had BMI values greater than 25, classifying them as overweight. An additional 5 had were classified as Class I obese (BMI 30.0 – 34.99) and 1 was classified as Class II obese (BMI 35.0 – 39.99).

The county in which all study procedures took place is consistently ranked among the most impoverished counties in the state of Kansas. The counties included in this study are known to have high rates of obesity, chronic disease and disease of cognitive decline.[4]

Definitions of Exercise and Physical Activity

The majority of study participants (n=22) were able to correctly distinguish between physical activity and exercise, regardless of group, gender, age, rural residence or retirement status, p<.05. Definitions of exercise and physical activity did not differ significantly between any groups. With the exception of one (n=1) individual, participants clearly defined physical activity as everyday movements, such as cleaning, walking the dog, work-related movement and other everyday tasks. Participants described physical activity as, "…things you do in normal life" and "…things you do throughout your day like housework, gardening, playing with your children, walking." Exercise, on the other hand, was described by participants as having some link to improving physical health and being more structured than physical activity. Definitions of exercise included, "Exercise is a planned program with specific targets. Exercise includes cardiovascular, strength, and flexibility conditioning," "…when you set out to do a workout. More planned and structured," and "Exercise is planned, probably more vigorous than physical activity, objective would be to improve strength, flexibility, endurance...etc."

Benefits of Exercise and Physical Activity

Participant responses for the benefits of exercise and physical activity did not vary significantly between study groups, p<.05. Due to small sample sizes, comparisons between sex, age, geographic proximity to town center and retirement status were not deemed statistically

powerful enough for statistical analyses. The most commonly reported benefits of exercise were brain health (n=14), improved overall health (n=13) and feeling better (n=11).

Barriers to Exercise

Most barriers to exercise were reported in similar frequency between groups. However, the time, reported as a barrier to exercise, was found to differ significantly between groups, $F_{(2,20)}=5.84$, $P<.05$. Follow up analysis revealed significant differences between the CON group and EDEX group for this reported barrier, $p<.05$. CON participants reported time as a barrier more frequently (62.50%) than EDEX participants (0.00%) Injury and illness (n=10), lack of motivation (n=9), weather (n=9) and time (n=7) were the most prevalent barriers to exercise reported (Table 3).

Barriers to Physical Activity

Groups did not differ significantly in their reported barriers to physical activity, $p<.05$. Injury and illness was the most prevalent barrier to physical activity reported (n=12). While other barriers were reported by a few individuals, frequencies were extremely low (Table 4).

Opportunities for Exercise and Physical Activity

All study groups reported similar opportunities for exercise and physical activity within and surrounding their communities, $p<.05$. All participants (n=23) acknowledged at least one opportunity for exercise and physical activity within their community. Walking (n=8) and gym memberships were cited most frequently as opportunities for exercise (Table 5).

Discussion

Previous studies have reported an inability of rural Midwestern adults to accurately distinguish between physical activity and exercise.[12] Surprisingly, this was not the case among the rural Kansas adults included in the present study. While it would be expected that individuals who had received healthy lifestyle behavior education would be able to clearly define the differences between exercise and PA, we did not expect the typical rural adult (CON participants) to correctly define these two terms. These results are promising. While previous studies reported confusion between PA and exercise among rural Midwestern adults, this population was able to clearly identify the distinguishing factors between the two. One participant understood physical activity to be "…doing chores, carrying boxes, basically anything you do in normal life…You're moving, but not at a level you hit your target heart rate." On the other hand, exercise was understood to be "…when you set out to do a workout. More planned and structured." Only one participant was unable to identify differences between the two. However, it is important to note the relatively small sample sizes utilized in this study. Further study is needed to determine whether this result would stand in much larger cohorts of rural Kansas adults.

Participants were able to identify numerous benefits of participating in physical activity and exercise. The benefits reported most frequently were brain health (N=14), feeling better (N=11) and improved overall health (N=13). It is not surprising that most participants cited brain health as an exercise-related benefit, given many of them (N=15) had received education on the association between exercise, physical activity and cognition.[47] However, while individuals may understand the benefits of exercise and physical activity, it is not evident whether this knowledge is being translated into action. Recent data suggests that 60% of adults in the geographic area

studies have access to at least one exercise facility. However, obesity rates within this region continue to rise and are well above the state average.[4] Further investigation is needed to better understand how to translate health knowledge into successful behavior change. Prior investigations suggest that social support and existing policies may play a key role in exercise initiation, adherence and enjoyment. While individuals may acknowledge the many benefits of exercise and PA, without a strong social support system and programs that reinforce exercise adherence, PA levels may continue to be lower than recommended.[2,7,12,14-17,19,21,22]

While numerous opportunities exist to participate in group fitness classes within the towns in question, reasons must exist that prevented individuals living within these towns to acknowledge these classes as realistic opportunities. Time, cost, type of classes, sex and other variables may play a role in whether middle age and older adults are willing to participate in such classes.

We expected financial constraints to be a significant barrier to exercise and PA. However, this was not the case. The only groups that appeared to view money as a significant barrier was males, compared to females. Again, larger sample sizes are needed to validate any difference. Men seemed to cite injury or illness more frequently than women. This may suggest that men are more likely to be impeded by injury or illness, or than they are have experienced more frequent injury and illness than females. Conclusions regarding sex differences for injury frequency and or severity cannot be made from the data collected and warrant future investigation.

As with previous studies of a similar nature, individuals were encouraged to share views regarding exercise and PA and the barriers they feel are most relevant to them personally and culturally. The most frequently reported barriers to exercise among rural Kansas adults were

injury or illness (N=10), lack of motivation (N=9) and weather (N=9) (Table 3). Individual

participant comments supported these themes. Comments on personal motivation included: "No

one to hold me accountable, but me!" "Sometimes my attitude is a significant behavior along

with lack of energy and motivation." "ME! I am the biggest barrier." The frigid wind and cold

winter weather was reported frequently as a weather-related barrier, and colds, chronic ailments,

surgeries and strained muscles were all listed as injury-related barriers. Interestingly, not one

participant cited lack of social support or caregiving responsibilities as a barrier to PA or

exercise. This differs from findings reported by Wilcox and colleagues.[7] These differences may

be related to the geographic variance between study populations. While weather may be a

prevalent barrier in Kansas, it may pose less of an obstacle in southern states, similar to that

investigated by Wilcox et al.[7]

Participants from the existing study who received no education or exercise (CON)

reported time as an exercise barrier significantly more frequently than EDEX participants. This is

not surprising and may be in part, due to the nature of the existing study. Previously sedentary

rural adults were provided with weekly supervised exercise in a semi-group format (EDEX),

while CON participants were instructed to continue their regular daily activities and received no

intervention. It may be plausible that EDEX participants realized that exercise can be efficient

and effective simultaneously, thus reducing the chances that they would cite time as a barrier to

exercise. Common statements from CON participants regarding time were: "Work schedule –

meetings every other week that last through the evening." "My job. Some days I work long

hours, and by the time I can choose to do something for myself, my energy is zapped." "TIME is

my biggest barrier.   I even bought a treadmill for my basement, but I can't get up early enough

to exercise and then get to work on time (I am stiff and slow in the morning). And by the time I

get home and take care of things, it is too late to exercise and be able to go to sleep. I have tried, and if I exercise past 7:30 pm, I am unable to go to sleep until MIDNIGHT! Uggh!" "Time, laziness."

The data analyzed for the purposes of this study were relatively small in sample size, compared to other, larger cohorts.[7,12,17] While studies have used similar sample sized in focus group or interview investigations,[12] larger sample sizes would increase the power of our data and potentially reveal additional associations.

In addition to open-ended questionnaires, future studies would be well-advised to include Likert scale surveys that list potential exercise/PA barriers and benefits. While open-ended responses reveal personal attitudes and views, providing all possible barriers and benefits would provide data that is organized into clear themes, while still allowing personal responses in additional space provided. This may reduce the chances that individuals overlook a barrier or benefit.

While the population used for this study is representative of the geographic region in question, future studies should attempt to include minority populations, as well as a variety of socioeconomic (SES) groups. Larger cohort data could be analyzed by county, SES status, education level, regular participation in exercise, BMI and ethnic or racial background, in addition to gender, age and rural-urban comparison. Further investigation is needed to support the findings of this study.

To the best of our knowledge, this is the first investigation of rural adults' attitudes and views on exercise and physical activity in Kansas. Rural Kansas adults seem to understand the many benefits that a physically active lifestyle produce. However, numerous barriers to both

physical activity and exercise exist for this population. Acquiring similar data from larger cohorts and addressing reported barriers to physical activity and exercise will be the focus of future investigations.

Conclusions

It is evident that rural Kansas adults acknowledge the benefits associated with exercise and physical activity. However, obesity rates remain high, as does the prevalence of chronic diseases, among this population.[4] Future investigations should utilize both open ended and multiple choice or Likert scale style surveys. Future surveys should include questions specific to rural lifestyle (e.g., farming, ranching), education attainment and job-related physical activity. Large scale data collection in a variety of rural Kansas communities will help community health professionals better address the barriers these populations face and design more effective health promotion programs.

Offering educational opportunities that provide efficient exercise options for rural adults may reduce barriers to exercise and increase exercise self-efficacy. Injury prevention education may be warranted as well. Evidence-based instruction that provides exercise opportunities and addresses appropriate modifications may not only reduce injury risk, but also reduce the fear of injury among RAs, increasing exercise self-efficacy and potentially participation and adherence rates. Finally, continued investigation into the most effective means of exercise, physical activity and healthy lifestyle education is needed across rural Kansas, as well as other rural Midwestern communities. Effective programs are needed that lead to lasting healthy behavior change. In order to effectively reduce the prevalence of chronic diseases, cognitive decline and lower obesity rates long-term, a stronger understanding of the cultural and personal norms that shape

behavior among these populations is required. Social, environmental and existing policy

constructs must be used to tailor community-specific interventions with lasting results.

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Tables and Figures

Table 1. Baseline Characteristics of Study Participants.

Characteristics	
Age, mean (SD) yrs.	61.09 (7.60
Female, No. (%)	15 (62.6)
Male, No. (%)	8 (34.8)
CON participants, No. (%)	8 (34.8)
ED participants, No. (%)	5 (21.7)
EDEX participants, No (%)	10 (43.5)
Weight, mean (SD) lbs.	173.89 (44.2)
Waist to hip ratio, mean (SD)	0.95 (0.1)
Rural/country resident, No. (%)	17 (73.9)
Residing within rural town, No. (%)	6 (26.1)
Obesity classification, No. (%)	
Overweight	9 (39.1)
Class I Obese	5 (21.7)
Class II Obese	1 (4.4)
Race/ethnicity, No. (%)	
White	23 (100.0)
Hispanic	0 (0)
Black/African American	0 (0)
Other	0 (0)
Retired, No. (%)	12 (52.2)

Table 2. Benefits of Exercise – rural, gender and age differences. Values are reported as No. (%).

Reported Benefits	Group							
	Country (N=6)	Town (N=17)	Male (N=8)	Female (N=15)	50-59 (N=13)	60-69 (N=7)	70-79 (N=2)	80-89 (N=1)
Brain health, No. (%)	3 (50.0)	11 (64.7)	6 (75.00)	8 (53.55)	8 (61.54)	3 (42.86)	2 (100.00)	1 (100.00)
Improve balance/flexibility, No. (%)	0 (0.0)	3 (17.7)	2 (25.00)	1 (6.67)	3 (23.08)	0 (0.00)	0 (0.00)	0 (0.00)
Improve strength/movement, No. (%)	2 (33.3)	8 (47.1)	5 (62.50)	5 (33.33)	5 (38.46)	3 (42.86)	1 (50.00)	1 (100.00)
Prevent falls, No. (%)	0 (0.0)	1 (5.9)	1 (12.50)	0 (0.00)	1 (7.69)	0 (0.00)	0 (0.00)	0 (0.00)
Control weight, No. (%)	0 (0.0)	5 (29.4)	2 (25.00)	3 (20.00)	3 (23.08)	1 (14.29)	1 (50.00)	0 (0.00)
Improve sleep, No. (%)	0 (0.0)	2 (11.8)	2 (25.00)	0 (0.00)	1 (7.69)	1 (14.29)	0 (0.00)	0 (0.00)
Reduce disease risk, No. (%)	1 (16.7)	4 (23.5)	4 (50.00)	1 (6.67)	2 (15.38)	1 (14.29)	2 (100.00)	0 (0.00)
Feel better, No. (%)	2 (33.3)	9 (52.9)	4 (50.00)	7 (46.67)	6 (46.15)	4 (57.14)	1 (50.00)	0 (0.00)
Reduce stress, No. (%)	2 (33.3)	0 (0.0)	0 (0.00)	2 (13.33)	1 (7.69)	1 (14.29)	0 (0.00)	0 (0.00)
Improve overall health, No. (%)	5 (83.3)	8 (47.1)	4 (50.00)	9 (60.00)	9 (69.23)	3 (42.86)	1 (50.00)	0 (0.00)
Lower blood pressure, No. (%)	1 (16.7)	0 (0.00)	0 (0.00)	1 (6.67)	1 (7.69)	0 (0.00)	0 (0.00)	0 (0.00)
Lower cholesterol, No. (%)	1 (16.7)	1 (5.9)	0 (0.00)	2 (13.33)	2 (15.38)	0 (0.00)	0 (0.00)	0 (0.00)
Heart health, No. (%)	1 (16.7)	1 (5.9)	1 (12.50)	1 (6.67)	2 (15.38)	0 (0.00)	0 (0.00)	0 (0.00)
Prevent injury, No. (%)	1 (16.7)	0 (0.00)	0 (0.00)	1 (6.67)	0 (0.00)	0 (0.00)	1 (50.00)	0 (0.00)

Table 3. Barriers to Exercise – Group, rural and gender differences. Values are reported as No. (%).

Reported Barriers	Group							
	CON (N=8)	ED (N=5)	EDEX (N=10)	TOTAL (N=23)	Country (N=6)	Town (N=17)	Male (N=8)	Female (N=15)
Injury / illness, No. (%)	2 (25.00)	3 (60.00)	5 (50.00)	10 (43.48)	1 (16.67)	9 (52.94)	6 (75.00)	4 (26.67)
Self-motivation, No. (%)	5 (62.50)	1 (20.00)	3 (30.00)	9 (39.13)	4 (66.67)	5 (29.41)	3 (37.50)	6 (40.00)
Lack of interest / priority, No. (%)	2 (25.00)	0 (0.00)	1 (10.00)	3 (13.04	2 (33.33)	1 (5.88)	1 (12.50)	2 (13.33)
Time, No. (%)	5 (62.50)	2 (40.0)	0 (0.00)	7 (30.43)	3 (50.00)	4 (23.53)	2 (25.00)	5 (33.33)
Weather, No. (%)	2 (25.00)	3 (60.00)	4 (40.00)	9 (39.13)	0 (0.00)	9 (52.94)	4 (50.00)	5 (33.33)
Social distractions, No. (%)	0 (0.00)	1 (20.00)	0 (0.00)	1 (4.35)	0 (0.00)	1 5.88)	0 (0.00)	1 (6.67)
Energy / attitude, No. (%)	3 (37.50)	0 (0.00)	1 (10.00)	4 (17.39)	0 (0.00)	4 23.53)	1 (12.50)	3 (20.00)
Body aches, No. (%)	2 (25.00)	0 (0.00)	0 (0.00)	2 (8.70)	1 (16.67)	1 (5.88)	1 (12.50)	1 (6.67)
No accountability, No. (%)	1 (12.50)	0 (0.00)	0 (0.00)	1 (4.35)	1 (16.67)	0 (0.00)	0 (0.00)	1 (6.67)
Location / available resources, No. (%)	2 (25.00)	1 (20.00)	1 (10.00)	4 (17.39)	2 (33.33)	2 (11.76)	2 (25.00)	2 (13.33)
Money, No. (%)	0 (0.00)	1 (20.00)	1 (10.00)	2 (8.70)	0 (0.00)	2 (11.76)	2 (25.00)	0 (0.00)

Table 4. Barriers to Physical Activity (PA) – rural, gender and retirement status differences. Values are reported as No. (%).

Reported Barriers	Group					
	Country (N=6)	Town (N=17)	Male (N=8)	Female (N=15)	Retired (N=12)	Working (N=11)
Injury / illness, No. (%)	1 (16.7)	11 (64.7)	7 (87.5)	5 (3.3)	3 (25.0)	9 (81.8)
Self-motivation, No. (%)	1 (16.7)	3 (17.7)	2 (25.0)	2 (13.3)	1 (8.3)	3 (27.3)
Limited mobility, No. (%)	0 (0.0)	1 (5.9)	1 (12.5)	0 (0.0)	0 (0.0)	1 (9.1)
Time, No. (%)	2 (33.3)	1 (5.9)	0 (0.0)	3 (20.0)	3 (25.0)	0 (0.0)
Weather, No. (%)	0 (0.0)	2 (11.8)	1 (12.5)	1 (6.7)	2 (16.7)	0 (0.0)
Sedentary job, No. (%)	1 (16.7)	0 (0.0)	0 (0.0)	1 (6.7)	1 (8.3)	0 (0.0)
No Accountability, No. (%)	0 (0.0)	1 (5.9)	1 (12.5)	0 (0.0)	0 (0.0)	1 (9.1)
Location / Available Resources, No. (%)	0 (0.0)	1 (5.9)	1 (12.5)	0 (0.0)	0 (0.0)	1 (9.1)

Table 5. Opportunities for Exercise – rural and gender differences.

Reported Opportunities	Group			
	Country (N=6)	Town (N=17)	Male (N=8)	Female (N=15)
Home exercise	0 (0.0)	2 (11.8)	1 (12.5)	1 (6.7)
Formal options	0 (0.0)	1 (5.9)	1 (12.5)	0 (0.0)
Job related	0 (0.0)	1 (5.9)	0 (0.0)	1 (6.7)
Walk	2 (33.3)	6 (35.3)	3 (37.5)	5 33.3)
Yard work	0 (0.0)	2 (11.8)	1 (12.5)	1 (6.7)
Disc golf	1 (16.7)	0 (0.0)	0 (0.0)	1 (6.7)
Tennis	1 (16.7)	0 (0.0)	0 (0.0)	1 (6.7)
Treadmill	1 (16.7)	0 (0.0)	0 (0.0)	1 (6.7)
Group Fitness Class	2 (33.3)	0 (0.0)	0 (0.0)	2 (13.3)
Bicycling	1 (16.7)	3 (17.7)	2 (25.0)	2 (13.3)
Golf	0 (0.0)	1 (5.9)	1 (12.5)	0 (0.0)
Swimming	0 (0.0)	1 (5.9)	1 (12.5)	0 (0.0)
Parks with trails	0 (0.0)	1 (5.9)	0 (0.0)	1 (6.7)
Gym membership	1 (16.7)	6 (35.3)	3 (37.5)	4 (26.7)

Appendix A

PAR-Q and You

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?
☐	☐	2.	Do you feel pain in your chest when you do physical activity?
☐	☐	3.	In the past month, have you had chest pain when you were not doing physical activity?
☐	☐	4.	Do you lose your balance because of dizziness or do you ever lose consciousness?
☐	☐	5.	Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?
☐	☐	6.	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
☐	☐	7.	Do you know of <u>any other reason</u> why you should not do physical activity?

If

you

answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to <u>all</u> PAR-Q questions, you can be reasonably sure that you can:
- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

→

DELAY BECOMING MUCH MORE ACTIVE:
- if you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- if you are or may be pregnant — talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

<u>Informed Use of the PAR-Q</u>: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____   DATE_____

SIGNATURE OF PARENT _____   WITNESS _____
or GUARDIAN (for participants under the age of majority)

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.
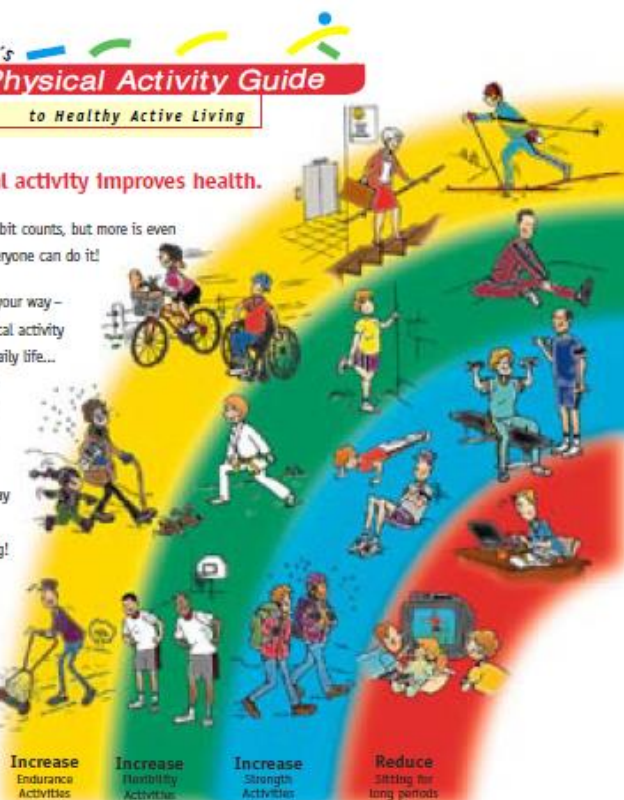
PAR-Q & YOU

...continued from other side

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)

Source: Canada's Physical Activity Guide to Healthy Active Living, Health Canada, 1998 http://www.hc-sc.gc.ca/hppb/paguide/pdf/guideEng.pdf
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FITNESS AND HEALTH PROFESSIONALS MAY BE INTERESTED IN THE INFORMATION BELOW:

The following companion forms are available for doctors' use by contacting the Canadian Society for Exercise Physiology (address below):

The **Physical Activity Readiness Medical Examination (PARmed-X)** – to be used by doctors with people who answer YES to one or more questions on the PAR-Q.

The **Physical Activity Readiness Medical Examination for Pregnancy (PARmed-X for Pregnancy)** – to be used by doctors with pregnant patients who wish to become more active.

References:
Arraix, G.A., Wigle, D.T., Mao, Y. (1992). Risk Assessment of Physical Activity and Physical Fitness in the Canada Health Survey
    Follow-Up Study. **J. Clin. Epidemiol.** 45:4 419-428.
Mottola, M., Wolfe, L.A. (1994). Active Living and Pregnancy, In: A. Quinney, L. Gauvin, T. Wall (eds.), **Toward Active Living: Proceedings of the International
    Conference on Physical Activity, Fitness and Health**. Champaign, IL: Human Kinetics.
PAR-Q Validation Report, British Columbia Ministry of Health, 1978.
Thomas, S., Reading, J., Shephard, R.J. (1992). Revision of the Physical Activity Readiness Questionnaire (PAR-Q). **Can. J. Spt. Sci.** 17:4 338-345.

For more information, please contact the:

Canadian Society for Exercise Physiology
202-185 Somerset Street West
Ottawa, ON K2P 0J2
Tel. 1-877-651-3755 • FAX (613) 234-3565
Online: www.csep.ca

The original PAR-Q was developed by the British Columbia Ministry of Health. It has been revised by an Expert Advisory Committee of the Canadian Society for Exercise Physiology chaired by Dr. N. Gledhill (2002).

Disponible en français sous le titre «Questionnaire sur l'aptitude à l'activité physique - Q-AAP (revisé 2002)».

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Appendix B

TAPA

TAPA 1: Aerobic

I am going to ask you about the amount and level of physical activity you usually do. In this survey, we define physical activities as activities where you move and increase your breathing or heart rate. These are activities you do for pleasure, work, or for getting around.

I will read a statement about activities, and you can tell me whether the statement describes you by answering *yes* or *no.* For example,

SAMPLE	I am over 50 years old. Does this describe you?	**Yes** □	**No** □	**Not Sure** □

Do the best you can to answer using the yes/no format; at the end of the survey we can talk about specific activities.

The first statement is

1	I rarely or never do any physical activities. Does this describe you?	**Yes** □	**No** □	**Not Sure** □

The next statements are about three types of activities: light, moderate, and vigorous. Light activities are activities when your heart beats only slightly faster than normal and you can still talk and sing during them. Some examples of light activities are walking leisurely, light vacuuming, light yard work, or light exercise such as stretching. Here are two statements about light activity.

2a	I do some **light** physical activities, but not every week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
3	I do some **light** physical activity every week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □

Next are moderate activities. Moderate activities are activities when your heart beats faster than normal. You can still talk but not sing during such activities. Some examples of moderate activities are fast walking, aerobics class, strength training, or swimming gently. I have four statements about moderate activities. The first one is

2b	I do some **moderate** physical activities, but not every week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
4a	I do some **moderate** physical activities every week, **BUT** less than 30 minutes per day. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
4b	I do some **moderate** physical activities every week, **BUT** less than 5 days per week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
6	I do 30 minutes or more per day of **moderate** physical activities, 5 or more days per week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □

The next three statements are about vigorous activities. Vigorous activities are activities when your heart rate increases a lot. You typically can't talk or your talking is broken up by large breaths. Some examples of

vigorous activities are jogging, running, using a stair machine, or playing tennis, racquetball, badminton, or pickleball. The first statement is

5a	I do some **vigorou**s physical activities every week, **BUT** less than 20 minutes per day. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
5b	I do some **vigorou**s physical activities every week, **BUT** less than 3 days per week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
7	I do 20 minutes or more per day of **vigorous** physical activities, 3 or more days per week. Does this describe you?	**Yes** □	**No** □	**Not Sure** □

TAPA 2: Strength & Flexibility

And finally, I have two statements about strengthening and stretching activities. First,

1	I do activities to increase muscle **strength**, such as lifting weights or calisthenics, once a week or more. Does this describe you?	**Yes** □	**No** □	**Not Sure** □
2	I do activities to improve **flexibility**, such as stretching or yoga, once a week or more. Does this describe you?	**Yes** □	**No** □	**Not Sure** □

Are there activities that you do that reflect physical activity that we may have not captured in this survey?

(Write in response)

This concludes my questions. Thank you.

TAPA 1: Aerobic, Scoring Instructions

To score, choose the question with the highest score with an affirmative response. Any number less than 6 is suboptimal.

For scoring or summarizing categorically:

Score as sedentary:

I rarely or never do any physical activities.

Score as underactive:

I do some light physical activities, but not every week, *or* I do some moderate physical activities, but not every week.

I do some light physical activity every week.

Score as underactive regular:

I do moderate physical activities every week, but less than 5 days per week or less than 30 minutes at a time.

I do vigorous physical activities every week, but less than 3 days per week or less than 20 minutes at a time.

Score as active:

I do 30 minutes or more per day of moderate physical activities, 5 or more days per week.

I do 20 minutes or more per day of vigorous physical activities, 3 or more days per week.

TAPA 2: Strength & Flexibility, Scoring Instructions

(Note: The authors made no analysis of TAPA 2 but present the scoring instructions in parentheses to make the complete TAPA questionnaire available to readers.)

I do activities to increase muscle strength, such as lifting weights or calisthenics, once a week or more. (1)

I do activities to improve flexibility, such as stretching or yoga, once a week or more. (2)

Both. (3)

None (0)

Appendix C

Informed Consent

CONSENT FORM
Altering Physical Barriers to Exercise and Physical Activity in Rural Kansas

You are being asked to join a research study examining the role of education and exercise on physical activity levels and Alzheimer's disease knowledge among residents of Rural Kansas. You are being asked to take part in this study because you are a resident of Lyon County, Kansas.

Research is voluntary, and you may change your mind at any time. There will be no penalty to you if you decide not to participate, or if you start the study and decide to stop early. Either way, you can still get medical care and services at the University of Kansas Medical Center (KUMC).

This consent form explains what you have to do if you are in the study. It also describes the possible risks and benefits. Please read the form carefully and ask as many questions as you need to, before deciding about this research.

You can ask questions now or anytime during the study. The researchers will tell you if they receive any new information that might cause you to change your mind about participating.

This research study will take place at Emporia State University Student Recreation Center in Emporia, Kansas, with Dr. Jeffrey Burns and Erin Blocker as the researchers. About 75 people will be in the study.

BACKGROUND
Alzheimer's disease (AD) is a progressive brain disorder which causes memory and thinking problems. Research has shown that exercise, specifically cardiovascular exercise, is an effective tool for maintaining brain volume and promoting healthy brain function in older adults.

Individuals who live in rural communities have different challenges that prevent them from exercising, compared to city-dwelling individuals. Some of these challenges might be fewer sidewalks, lack of facilities, chronic illness and education about the benefits of exercise.

Unfortunately, rural Americans report lower levels of physical activity and experience higher rates of chronic disease, including AD. We hope to learn more about these barriers and develop potential strategies for overcoming these unique barriers to physical activity.

PURPOSE

By doing this study, researchers hope to improve understanding about the relationship between AD and physical activity and develop strategies to increase physical activity levels in rural dwelling Kansans. Part of this study is to determine if exercise programs can be successfully implemented in rural Kansas communities.

PROCEDURES

If you decide to participate you will be asked to sign this consent form and a signed copy will be given to you for your records.

If you are eligible and decide to participate in this study, your participation will last approximately 3 months. Your participation will involve screening evaluations to assess your knowledge of Alzheimer's disease, quality of daily living, and physical fitness. These evaluations may take up to 30 days to complete.

If you are eligible, you will be randomly assigned (like a flip of a coin) to either:

- Group 1: Education
- Group 2: Education + Exercise intervention group
- Group 3: Control group.

You will have even chances of being placed in the any one of the groups.

EDUCATION GROUP (E)

If you are assigned to the education group, you will be provided with weekly educational sessions, led by the research team. These sessions will last approximately 45-60 minutes and will provide information on physical activity, exercise and other healthy lifestyle behaviors. You will also receive materials on exercise and healthy lifestyle, and a device

to track your physical activity throughout the study period. You will not receive supervised exercise.

Prior to Study	Weekly (10 wks)	After Study
Physical Fitness Assessments	Weekly Physical Activity Log	Physical Fitness Assessments
Healthy Lifestyle Survey	Educational Seminar	Healthy Lifestyle Survey
Descriptive physical measures		Descriptive physical measures
		Assessment of Program

EDUCATION + EXERCISE GROUP (E+E)

If you are assigned to the education + exercise intervention group, you will be provided with 10 weeks of supervised exercise sessions, in addition to the educational materials and sessions described above.

You will be asked to exercise at the designated exercise facility 3-5 days per week for 10 weeks under the supervision of the research team. All exercise sessions will be led by the research team and will take place at the Emporia State University Student Recreation Center. Prior to starting your program, you will be asked to attend an orientation session at the facility which will be conducted by one of the study staff. This session will last approximately one hour. You will be asked to follow the study's exercise program throughout the 10 week study period.

Exercise will consist of walking on an indoor track or using other aerobic exercise equipment, light free weight exercises and exercises using resistance training equipment. During week 1 of the exercise program, your will start performing 60 minutes of exercise per week spread over 3 days. Each week, the exercise duration will gradually increase, reaching a maximum of 120-150 minutes per week. You may slow down and stop to rest at any time during the exercise sessions.

In the event that you are not able to exercise at the facility due to travel plans, family obligations, etc., you will be encouraged to continue the exercise regimen on your own. The research team will provide exercise training plans in these circumstances.

Prior to Study	Weekly	After Study
Physical Fitness Assessments	Weekly Physical Activity Log	Physical Fitness Assessments
Healthy Lifestyle Survey	Educational Seminar	Healthy Lifestyle Survey
Descriptive physical measures	3 Exercise Sessions	Descriptive physical measures
		Assessment of Program

CONTROL GROUP (C)

If you are assigned to the control group, you will be provided materials on exercise and healthy lifestyle, but you will not be provided support or guidance with an exercise program, and will not attend the educational seminars. At the end of the study, you will be provided with 10 weeks of exercise intervention (described above) free of charge to you.

Prior to Study	Weekly	After Study
Physical Fitness Assessments		Physical Fitness Assessments
Healthy Lifestyle Survey		Healthy Lifestyle Survey
Descriptive physical measures	No action required	
		Descriptive physical measures
		Assessment of Program

Regardless of group assignment, you will be asked to repeat all of the clinical and physical fitness assessments at Week 10 of the study.

The following is a description of each test and procedure listed above:

Medical History and Current Medications: You will be asked about your medical history, such as surgeries, medical illnesses or reactions, or medications and supplements you are taking. Every time you are contacted by study staff you may be asked about changes in your health or the medicines and supplements you take.

Modified Healthy Lifestyle Profile II: This survey will take approximately 20-30 minutes to complete. You will be asked to answer a number of questions regarding your daily physical activity levels, nutrition and outlook on life, among other variables.

<u>Physical Measures and Fitness Level Assessments:</u> These following assessments will be completed in one visit, which will take approximately 1 hour to complete.

- <u>Descriptive Physical Measures:</u> Your height, weight and blood pressure will be measured and recorded. Your waist and hip circumference will also be measured. Your waist to hip ratio will be calculated from these measurements.
- <u>Physical Fitness Level Assessments:</u> You will have several standardized tests to measure your ability to perform physical activities such as rising from a chair, and stepping onto and off of an 18" step. You will perform each activity for a given time (Ex. 30 sec. chair sit and stand test), and your results will be recorded.

<u>Program Assessment:</u> After completing the study, you will be asked to assess the effectiveness of the program. You will be provided with several statements and asked to rate each statement on a scale of 1-5.

Testing Results

The data collected in this study are intended for research and do not necessarily provide the same information that a physician would use for a clinical evaluation.

At the end of the study you will be given copies of your pre and post-exercise physical fitness level assessments. We will explain your results.

Is there any way being in this study could harm me?

You may experience one or more of the following risks by being in this study. In addition, there may be other unknown risks, or risks that we did not anticipate, associated with being in this study.

<u>Modified Healthy Lifestyle Profile II and Quality of Life Assessment Risks:</u>

There is a risk of feeling uncomfortable or embarrassed by some of the questions the researchers ask you. If you feel uncomfortable you may skip a question or stop participating all together.

Physical Function, Fitness Level Assessment and Exercise Program Risks:

Exercise testing is commonly performed on individuals with heart disease and these studies can be used to provide an estimate of the test's risk in healthy older adults. The risk of exercise testing in healthy older adults appears to be low. The fitness level assessment is intended to evaluate your maximal exercise ability, so you will be asked to exercise to the point of fatigue. You may experience shortness of breath, dizziness, muscle fatigue, sweating, fatigue, muscle soreness, injury to tendons, ligaments, joints, bone or muscle during the testing. You may experience muscle soreness for up to 3 days after testing. Although rare, with any form of exercise, potential risks of the exercise test include unpredictable changes in blood pressure or heart rhythm, heart attack and death.

Possibility of Unknown Risks
There may be other side effects or risks that are not yet known.

NEW INFORMATION
You will be told about anything new that might change your decision to be in this study. You may be asked to sign a new consent form if this occurs.

Will being in this study help me in any way?

You may or may not benefit from this study. Researchers hope that the information from this research study may be useful in the prevention and deterrence of AD in the future.

What other choices to do I have?

This research project is voluntary. The alternative to this study is to receive your usual care from your clinician.

Will it cost anything to be in the study?
Other than the gas, to get to and from your clinical assessments and to your exercise facility, there should be no cost to you for participating in this study. You and your insurance company will be charged for the health care services that you would ordinarily be responsible to pay.

What happens if I am hurt by the study?

If you have any problem during the study, you should immediately contact Dr. Burns at 913-588-0555. If the problem is a medical emergency, call 911.

INSTITUTIONAL DISCLAIMER

If you think you have been harmed as a result of participating in research at the University of Kansas Medical Center (KUMC), you should contact the Director, Human Research Protection Program, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160. Under certain conditions, Kansas state law or the Kansas Tort Claims Act may allow for payment to persons who are injured in research at KUMC.

CONFIDENTIALITY AND PRIVACY AUTHORIZATION

The researchers will protect your information, as required by law. Absolute confidentiality cannot be guaranteed because persons outside the study team may need to look at your study records. The researchers may publish the results of the study. If they do, they will only discuss group results. Your name will not be used in any publication or presentation about the study.

Your health information is protected by a federal privacy law called HIPAA. By signing this consent form, you are giving permission for KUMC to use and share your health information. If you decide not to sign the form, you cannot be in the study.

The researchers will only use and share information that is needed for the study. To do the study, they will collect health information from the study activities. You may be identified by information such as name, address, phone, date of birth, social security number, or other identifiers. The health information will be used at KUMC by Dr. Burns, members of the research team, the KUMC Research Institute and officials at KUMC who oversee research, including members of the KUMC Human Subjects Committee and other committees and offices that review and monitor research studies.

All study information that is sent outside KU Medical Center will have your name and other identifying characteristics removed, so that your identity will not be known. Because identifiers will be removed, your health information will not be re-disclosed by outside persons or groups and will not lose its federal privacy protection.

Your permission to use and share your health information will not expire unless you cancel it.

QUESTIONS

Before you sign this form, Dr. Burns, Erin Blocker or other members of the study team should answer all your questions. You can talk to the researchers if you have any more questions, suggestions, concerns or complaints after signing this form. If you have any questions about your rights as a research subject, or if you want to talk with someone who is not involved in the study, you may call the Human Subjects Committee at (913) 588-1240. You may also write the Human Subjects Committee at Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160.

SUBJECT RIGHTS AND WITHDRAWL FROM THE STUDY

You may stop being in the study at any time. Your decision to stop will not prevent you from getting treatment or services at KUMC. The entire study may be discontinued for any reason without your consent by the investigator conducting the study.

You have the right to cancel your permission for researchers to use your health information. If you want to cancel your permission, please write to Dr. Jeffrey Burns. The mailing address is Dr. Jeffrey Burns, University of Kansas Medical Center, 4350 Shawnee Mission Parkway, Fairway, KS 66205. If you cancel permission to use your health information, you will be withdrawn from the study. The researchers will stop collecting any additional information about you unless they need information about a side effect of the intervention. They may use and share information that was gathered before they received your cancellation.

Can my participation be stopped early?

This study might be stopped, without your consent, by the investigator or the sponsor. Possible reasons for removal include failure to comply with study procedures, inappropriate behavior towards study staff or the end of funding for the study.

Neither the sponsor, nor the investigator, nor the University of Kansas Medical Center,

nor the University of Kansas will be obligated to provide you with the study treatment if the study is stopped early. Your physician will decide about future treatment, if it is needed.

CONSENT

Dr. Burns, Erin Blocker or the research team has given you information about this research study. They have explained what will be done and how long it will take. They explained any inconvenience, discomfort or risks that may be experienced during this study.

By signing this form, you say that you freely and voluntarily consent to participate in this research study. You have read the information and had your questions answered.

You will be given a signed copy of the consent form to keep for your records.

_____

Print Participant's Name

_____   _____   _____

Signature of Participant   Time   Date

_____

Print Name of Person Obtaining Consent

_____   _____

Signature of Person Obtaining Consent   Date

Appendix D

Assumption of Risk

ASSUMPTION OF RISK:

There are many special benefits from the activities being afforded to participants engaging in the Alzheimer's Disease Prevention Project offered through the KU Alzheimer's Disease Center, the University of Kansas and Emporia State University. Within the activities it must be understood that there are dangers that may lead to injury to individuals. Therefore, participants should be aware that dangers do exist and that participation is done with the understanding of the risks involved. It must also be understood that participants must share in the responsibility for their own safety and the safety of others.

The participants involved in the Alzheimer's Disease Prevention project could mildly, moderately or severely injure the anatomy in one or several of the following: muscles, tendons, ligaments, bone, skin teeth and any of the vital organs. Catastrophic injuries of death and permanent paralysis may occur during participation. There is not an absolute preventative against any of the mentioned potential injury sites.

Any costs as the result of injury or illness connected with participation in these courses/activities are solely the responsibility of the participant. If you have a disability that you believe requires accommodation, please notify the research team prior to participation in the activity.

I have read and understand this statement.

Name (print): _____

Signature: _____   Date: _____

The research team will not be held responsible for any items brought to the student recreation center. This is true for backpacks, bags, purses, jewelry, etc. It is recommended that all participants leave their belongings in one of the lockers provided at the Student Recreation Center.

Appendix E

Queen's College Step Test

Client Name: _____   **Queens College Step Test (McArdle)**

- **Resting Measures**

    RHR: _____   RBP: _____   Age: _____

    Body Weight (kg) (lbs/2.2): _____   Height (cm) (in * 2.54): _____

- **Equipment needed:**

    o   16.25 inch (41.3 cm) step
    - Many gymnasium bleachers have a riser height of 16.25"
    - Stopwatch, Metronome, and HR Monitor (optional)

- **Basic Procedure:**   (p 113 of *ACSM's Health-Related Physical Fitness Assessment Manual*)

    - Men step up and down on the step at a cadence of 24 per minute. (96 beats per minute)
    - Women step at a cadence of 22 per minute. (88 beats per minute)

        - A cadence is a complete cycle of 4 steps: step up with one leg, step up with the other, step down with the first leg, and finally step down with the last leg. In other words, there are 4 steps per cadence: up, up, down, down
        - A metronome is set at 4 times the cadence to coordinate each leg's movement with the beat of the metronome. So with each beat of the metronome, one of the steps is taken (up, up, down, or down). For men, the metronome is to be set at 96 beats per minute and for women it is to be set at 88 beats per minute.

    The total test time for both men and women is 3 minutes. At the end of the 3 minutes, the participant stops and the recovery HR (bpm) is determined.

    - If using a HR monitor, record the bpm at 15 seconds after test completion
    - If palpating, the recovery HR should be taken between 5 and 20 seconds from the end of the test (multiply that number by 4 to calculate the recovery HR)

    - **Estimate VO$_{2max}$** by using the Results section below. Use the Normative VO$_2$ chart to determine **Fitness Classification**

    Results: Recovery HR: _____

        MEN: Estimated VO$_{2max}$ = 111.33 – (0.42 x HR)
        WOMEN: Estimated VO$_{2max}$ = 65.81 – (0.1847 x HR)

    Example: If a male finished the test with a recovery HR of 144bpm (36 beats in 15 seconds) then:
                Estimated VO$_{2max}$ = 111.33 – (0.42 x 144)
                Estimated VO$_{2max}$ = 50.85 ml/kg/min

VO$_{2max}$ Estimate = _____ **ml/kg/min**   **Percentile Value:** _____

Fitness Classification: _____

TEST VERIFIED BY (Lab Assistant/Date): _____

Normative data for VO$_{2max}$

TABLE 4-8. Percentile Values for Maximal Aerobic Power (mL·kg^{-1}·min^{-1})*

Percentile values for maximal oxygen uptake (mL·kg^{-1}·min^{-1}) in men.

Percentile	20–29 (N = 2,234)	30–39 (N = 11,158)	40–49 (N = 13,109)	50–59 (N = 5,641)	60+ (N = 1,244)
90	55.1	52.1	50.6	49.0	44.2
80	52.1	50.6	49.0	44.2	41.0
70	49.0	47.4	45.8	41.0	37.8
60	47.4	44.2	44.2	39.4	36.2
50	44.2	42.6	41.0	37.8	34.6
40	42.6	41.0	39.4	36.2	33.0
30	41.0	39.4	36.2	34.6	31.4
20	37.8	36.2	34.6	31.4	28.3
10	34.6	33.0	31.4	29.9	26.7

*Data were obtained from the initial examination of apparently healthy men enrolled in the Aerobics Center Longitudinal Study (ACLS), 1970 to 2002. The study population for the data set was predominantly White and college educated. Maximal treadmill exercise tests were administered using a modified Balke protocol. Maximal oxygen uptake was estimated from the final treadmill speed and grade using the current ACSM equations found in this edition of the Guidelines. The data are provided courtesy of the ACLS investigators, The Cooper Institute, Dallas, TX. The ACLS is supported in part by a grant from the National Institute on Aging (AG06945), SN Blair, Principal Investigator. The following may be used as descriptors for the percentile rankings: well above average (90), above average (70), average (50), below average (30), and well below average (10).

Percentile values for maximal oxygen uptake (mL·kg^{-1}·min^{-1}) in women.

Percentile	20–29 (N = 1,223)	30–39 (N = 3,895)	40–49 (N = 4,001)	50–59 (N = 2,032)	60+ (N = 465)
90	49.0	45.8	42.6	37.8	34.6
80	44.2	41.0	39.4	34.6	33.0
70	41.0	39.4	36.2	33.0	31.4
60	39.4	36.2	34.6	31.4	28.3
50	37.8	34.6	33.0	29.9	26.7
40	36.2	33.0	31.4	28.3	25.1
30	33.0	31.4	29.9	26.7	23.5
20	31.4	29.9	28.3	25.1	21.9
10	28.3	26.7	25.1	21.9	20.3

*Data were obtained from the initial examination of apparently healthy women enrolled in the Aerobics Center Longitudinal Study (ACLS), 1970 to 2002. The study population for the data set was predominantly White and college educated. Maximal treadmill exercise tests were administered using a modified Balke protocol. Maximal oxygen uptake was estimated from the final treadmill speed and grade using the current ACSM equations found in this edition of the Guidelines. The data are provided courtesy of the ACLS investigators, The Cooper Institute, Dallas, TX. The ACLS is supported in part by a grant from the National Institute on Aging (AG06945), SN Blair, Principal Investigator. The following may be used as descriptors for the percentile rankings: well above average (90), above average (70), average (50), below average (30), and well below average (10).

Fitness Classifications for VO$_{2max}$

Percentile	Descriptor (Fitness Classification)
≥ 90	Well above Average (Excellent)
70 – 89	Above Average
50 – 69	Average
30 – 59	Below Average (Poor)
≤ 29	Well below Average (Very Poor)

Instructions:

Use the estimated VO$_{2max}$ value from your CRF test and with the Normative data for VO$_{2max}$ table at the left, determine which percentile your subject belongs.

Then using the Fitness Classifications for VO$_{2max}$ table above, determine his/her fitness classification. Record the information on the data collection sheet.

Example:

Age/sex = 24 year old male
Estimated VO$_{2max}$ value = 45 ml/kg/min
Percentile = ~52-53
Fitness Classification = Average

Appendix F

30 Second Chair Test

The 30-Second Chair Stand Test

Purpose: To test leg strength and endurance

Equipment:

- A chair with a straight back without arm rests (seat 17″ high)
- A stopwatch

Instructions to the patient:

1. Sit in the middle of the chair.

2. Place your hands on the opposite shoulder crossed at the wrists.

3. Keep your feet flat on the floor.

4. Keep your back straight and keep your arms against your chest.

5. On **"Go,"** rise to a full standing position and then sit back down again.

6. Repeat this for 30 seconds.

On **"Go,"** begin timing.

If the patient must use his/her arms to stand, stop the test. Record "0" for the number and score.

Count the number of times the patient comes to a full standing position in 30 seconds.

If the patient is over halfway to a standing position when 30 seconds have elapsed, count it as a stand.

Record the number of times the patient stands in 30 seconds.

Number: _____ **Score** _____ **See next page.**

A below average score indicates a high risk for falls.

Notes:

Chair Stand—Below Average Scores

Age	Men	Women
60-64	< 14	< 12
65-69	< 12	< 11
70-74	< 12	< 10
75-79	< 11	< 10
80-84	< 10	< 9
85-89	< 8	< 8
90-94	< 7	< 4

Appendix G

Blood Pressure Health Categories

Instructions for Measuring Blood Pressure

1. To monitor your blood pressure, we will be using an automatic blood pressure monitor (OMRON 10 series).
2. We will find a comfortable place to sit with good back support at a table or desk and remain seated for 3-5 minutes before measuring your blood pressure.
3. Please place your feet flat on the floor and rest your arm, palm facing up on your desk. Make sure your arm is even with your heart.
4. We will place the cuff on your bare upper arm, 1" above the your elbow. We will make sure the cuff is tight enough by ensuring we can only put 2 of fingers in between the cuff and your skin.
5. You will be asked to sit quietly and calmly, and we will press the start button. Remain still and relaxed during the measurements. The cuff will inflate, becoming tight around your arm. It will deflate automatically as well.
6. When the measurement is complete, the monitor will display your blood pressure and pulse on the screen.
7. If the monitor doesn't work for some reason, we will wait a few minutes and try again.
8. You will be able to read your blood pressure measurements on the device's screen upon completion.

Reading Your Blood Pressure

- **Top Number** = systolic blood pressure

- **Bottom Number** = diastolic blood pressure

- **Pulse = Heart Rate (beats/min.)**

- Blood pressure categories and health risks are detailed in the table below.

Blood Pressure Category	Systolic mm Hg (upper #)		Diastolic mm Hg (lower #)
Low blood pressure (Hypotension)	less than 90	or	less than 60
Normal	90 to 120	and	60 to 80
Prehypertension	120-139	or	80-89
High Blood Pressure (Hypertension Stage 1)	140-159	or	90-99
High Blood Pressure (Hypertension Stage 2)	160 or higher	or	100 or higher
High Blood Pressure Crisis (Seek Emergency Care)	180 or higher	or	110 or higher

Appendix H

BMI Classifications and Health Risks

BMI Classifications & Associated Health Risks

BMI	Classification	Health Risk
< 18.5	Underweight	Increased
18.5 - 24.9	Normal Weight	Minimal
25 - 29.9	Overweight	Increased
30 - 34.9	Obese (Obesity Class I)	High
35-39.9	Severely Obese (Obesity Class II)	Very High
≥ 40	Morbidly Obese (Obesity Class III)	Extremely High

Adapted from Nieman, D.C., *Exercise Testing and Prescription* (2007) and *ACSM's Guidelines for Exercise Testing and Prescription* (2006).

Appendix I

Girth Measurements, Waist to Hip Ratio and Health Risks

Client Name: _____   **Circumferences (Waist & WHR)**

- **Resting Measures:**   Age: _____

  RHR: _____   RBP: _____

  Body Weight in kg (lbs/2.2): _____   Height in cm (in * 2.54): _____

- **Basic Procedure:**

  - **Note:** for best results, client should wear minimal clothing. Waist measure should be done against skin if possible; hip measurement should be done against tight clothing.

    o The client should stand upright and relaxed, with feet together and arms at the side
      - The arms should only be raised high enough to allow for taking of measurements.
    o Determine appropriate waist and hip circumference sites (see illustrations on reverse)
      - Waist (abdominal) circumference is defined as the **smallest waist circumference** below the rib cage and above the umbilicus while standing with abdominal muscles relaxed (not pulled in)
      - Hip (gluteal) circumference is defined as the **largest circumference of the buttocks-hip** area while the person is standing
    o Avoid any air space between the tape and the skin by pulling the tape tight, but not so tight that it indents the skin (use spring-loaded Gulick tape if possible)
    o Make sure tape is horizontal around entire circumference (have partner check or use wall-mounted mirror)
    o Measure to the nearest 1/16" or 0.50cm (5mm). Take 3 measurements (should be within 7mm of each other)
    o Average the 3 measurement to determine final circumferences
    o **Waist-to-Hip Ratio (WHR) is calculated** simply by dividing the average waist measurement by the average hip measurement
      - WHR = Waist ÷ Hip

- **Results:**

  Waist

  Trial 1: _____   Trial 2: _____   Trial 3: _____

  Average of the three trials: _____

  Hip

  Trial 1: _____   Trial 2: _____   Trial 3: _____

  Average of the three trials: _____

  After measuring the circumferences according to the procedure below and doing the appropriate calculation, consult the Waist Circumference and WHR Classification & Associated Health Risk Charts to complete the assessment

  Waist Circumference: _____   **Health Risk: _____**

  Waist-to-Hip Ratio: _____   **Health Risk: _____**

  Note: WHR has fallen out of favor in many circles in preference to a combination of simple waist circumference and skinfold results and/or BMI. The ACSM recommends a minimum of either waist circumference or BMI, but preferably both, for risk stratification.

TEST VERIFIED BY (Lab Assistant/Date): _____

Waist-to-Hip Ratio (WHR) & Associated Health Risks

TABLE 4-4	WAIST-TO-HIP CIRCUMFERENCE RATIO (WHR) STANDARD FOR MEN AND WOMEN				
		Risk			
	Age	Low	Moderate	High	Very High
Men	20–29	<0.83	0.83–0.88	0.89–0.94	>0.94
	30–39	<0.84	0.84–0.91	0.92–0.96	>0.96
	40–49	<0.88	0.88–0.95	0.96–1.00	>1.00
	50–59	<0.90	0.90–0.96	0.97–1.02	>1.02
	60–69	<0.91	0.91–0.98	0.99–1.03	>1.03
Women	20–29	<0.71	0.71–0.77	0.78–0.82	>0.82
	30–39	<0.72	0.72–0.78	0.79–0.84	>0.84
	40–49	<0.73	0.73–0.79	0.80–0.87	>0.87
	50–59	<0.74	0.74–0.81	0.82–0.88	>0.88
	60–69	<0.76	0.76–0.83	0.84–0.90	>0.90

(Reprinted with permission from Heyward VH, Stolarczyk LM. Applied Body Composition Assessment. Champaign, IL: Human Kinetics, 1996:82).

Appendix J

Alzheimer's Disease Knowledge Scale (ADKS); Assessment tool and answer key

Alzheimer's Disease Knowledge Scale

Below are some statements about Alzheimer's disease. Please read each statement carefully and circle whether you think the statement is True or False. If you aren't sure of the right answer, make your best guess. It's important to circle an answer for every statement, even if you're not completely sure of the answer.

True   False   1.   People with Alzheimer's disease are particularly prone to depression.

True   False   2.   It has been scientifically proven that mental exercise can prevent a person from getting Alzheimer's disease.

True   False   3.   After symptoms of Alzheimer's disease appear, the average life expectancy is 6 to 12 years.

True   False   4.   When a person with Alzheimer's disease becomes agitated, a medical examination might reveal other health problems that caused the agitation.

True   False   5.   People with Alzheimer's disease do best with simple, instructions given one step at a time.

True   False   6.   When people with Alzheimer's disease begin to have difficulty taking care of themselves, caregivers should take over right away.

True   False   7.   If a person with Alzheimer's disease becomes alert and agitated at night, a good strategy is to try to make sure that the person gets plenty of physical activity during the day.

True   False   8.   In rare cases, people have recovered from Alzheimer's disease.

True   False   9.   People whose Alzheimer's disease is not yet severe can benefit from psychotherapy for depression and anxiety.

True   False   10.   If trouble with memory and confused thinking appears suddenly, it is likely due to Alzheimer's disease.

True   False   11.   Most people with Alzheimer's disease live in nursing homes.

True   False   12.   Poor nutrition can make the symptoms of Alzheimer's disease worse.

True   False   13.   People in their 30s can have Alzheimer's disease.

True   False   14.   A person with Alzheimer's disease becomes increasingly likely to fall down as the disease gets worse.

True   False   15.   When people with Alzheimer's disease repeat the same question or story several times, it is helpful to remind them that they are repeating themselves.

True   False   16.   Once people have Alzheimer's disease, they are no longer capable of making informed decisions about their own care.

True   False   17.   Eventually, a person with Alzheimer's disease will need 24-hour supervision.

True   False   18.   Having high cholesterol may increase a person's risk of developing Alzheimer's disease.

True   False   19.   Tremor or shaking of the hands or arms is a common symptom in people with Alzheimer's disease.

True   False   20.   Symptoms of severe depression can be mistaken for symptoms of Alzheimer's disease.

True   False   21.   Alzheimer's disease is one type of dementia.

True   False   22.   Trouble handling money or paying bills is a common early symptom of Alzheimer's disease.

True   False   23.   One symptom that can occur with Alzheimer's disease is believing that other people are stealing one's things.

True   False   24.   When a person has Alzheimer's disease, using reminder notes is a crutch that can contribute to decline.

True   False   25.   Prescription drugs that prevent Alzheimer's disease are available.

| True | False | 26. | Having high blood pressure may increase a person's risk of developing Alzheimer's disease. |

| True | False | 27. | Genes can only partially account for the development of Alzheimer's disease. |

| True | False | 28. | It is safe for people with Alzheimer's disease to drive, as long as they have a companion in the car at all times. |

| True | False | 29. | Alzheimer's disease cannot be cured. |

| True | False | 30. | Most people with Alzheimer's disease remember recent events better than things that happened in the past. |

Source. Carpenter, B.D., Balsis, S., Otilingam, P.G., Hanson, P.K., & Gatz, M. (in press). The Alzheimer's Disease Knowledge Scale: Development and psychometric properties. *The Gerontologist*.

Alzheimer's Disease Knowledge Scale - KEY

Below are some statements about Alzheimer's disease. Please read each statement carefully and circle whether you think the statement is True or False. If you aren't sure of the right answer, make your best guess. It's important to circle an answer for every statement, even if you're not completely sure of the answer.

True	False	1.	People with Alzheimer's disease are particularly prone to depression.
True	**False**	2.	It has been scientifically proven that mental exercise can prevent a person from getting Alzheimer's disease.
True	False	3.	After symptoms of Alzheimer's disease appear, the average life expectancy is 6 to 12 years.
True	False	4.	When a person with Alzheimer's disease becomes agitated, a medical examination might reveal other health problems that caused the agitation.
True	False	5.	People with Alzheimer's disease do best with simple, instructions given one step at a time.
True	**False**	6.	When people with Alzheimer's disease begin to have difficulty taking care of themselves, caregivers should take over right away.
True	False	7.	If a person with Alzheimer's disease becomes alert and agitated at night, a good strategy is to try to make sure that the person gets plenty of physical activity during the day.
True	**False**	8.	In rare cases, people have recovered from Alzheimer's disease.
True	False	9.	People whose Alzheimer's disease is not yet severe can benefit from psychotherapy for depression and anxiety.
True	**False**	10.	If trouble with memory and confused thinking appears suddenly, it is likely due to Alzheimer's disease.

True   <u>False</u>   11.   Most people with Alzheimer's disease live in nursing homes.

<u>True</u>   False   12.   Poor nutrition can make the symptoms of Alzheimer's disease worse.

<u>True</u>   False   13.   People in their 30s can have Alzheimer's disease.

<u>True</u>   False   14.   A person with Alzheimer's disease becomes increasingly likely to fall down as the disease gets worse.

True   <u>False</u>   15.   When people with Alzheimer's disease repeat the same question or story several times, it is helpful to remind them that they are repeating themselves.

True   <u>False</u>   16.   Once people have Alzheimer's disease, they are no longer capable of making informed decisions about their own care.

<u>True</u>   False   17.   Eventually, a person with Alzheimer's disease will need 24-hour supervision.

<u>True</u>   False   18.   Having high cholesterol may increase a person's risk of developing Alzheimer's disease.

True   <u>False</u>   19.   Tremor or shaking of the hands or arms is a common symptom in people with Alzheimer's disease.

<u>True</u>   False   20.   Symptoms of severe depression can be mistaken for symptoms of Alzheimer's disease.

<u>True</u>   False   21.   Alzheimer's disease is one type of dementia.

<u>True</u>   False   22.   Trouble handling money or paying bills is a common early symptom of Alzheimer's disease.

<u>True</u>   False   23.   One symptom that can occur with Alzheimer's disease is believing that other people are stealing one's things.

True   False   24.   When a person has Alzheimer's disease, using reminder notes is a crutch that can contribute to decline.

True   False   25.   Prescription drugs that prevent Alzheimer's disease are available.

True   False   26.   Having high blood pressure may increase a person's risk of developing Alzheimer's disease.

True   False   27.   Genes can only partially account for the development of Alzheimer's disease.

True   False   28.   It is safe for people with Alzheimer's disease to drive, as long as they have a companion in the car at all times.

True   False   29.   Alzheimer's disease cannot be cured.

True   False   30.   Most people with Alzheimer's disease remember recent events better than things that happened in the past.

Source. Carpenter, B.D., Balsis, S., Otilingam, P.G., Hanson, P.K., & Gatz, M. (in press). The Alzheimer's Disease Knowledge Scale: Development and psychometric properties. *The Gerontologist*.

Appendix K

Formatted Healthy Lifestyle Profile II (HLPLII)

KU Revised - LIFESTYLE PROFILE II (HPLP II)

DIRECTIONS: *This questionnaire contains statements about your present way of life or personal habits. Please respond to each item as accurately as possible, and try not to skip any item. Indicate the frequency with which you engage in each behavior by circling one of the choices.*

1.	Choose a diet low in saturated fat.	**Never**	**Sometimes**	**Often**	**Routinely**
2.	Follow a planned exercise program.	**Never**	**Sometimes**	**Often**	**Routinely**
3.	Get enough sleep.	**Never**	**Sometimes**	**Often**	**Routinely**
4.	Feel I am growing and changing in positive ways.	**Never**	**Sometimes**	**Often**	**Routinely**
5.	Limit use of sugars and food containing sugar (sweets).	**Never**	**Sometimes**	**Often**	**Routinely**
6.	Take part in moderate physical activity (such as sustained walking) for at least 30 minutes on most days of the week.	**Never**	**Sometimes**	**Often**	**Routinely**
7.	Take some time for relaxation each day.	**Never**	**Sometimes**	**Often**	**Routinely**
8.	Believe that my life has purpose.	**Never**	**Sometimes**	**Often**	**Routinely**
9.	Eat at least 3 servings of whole grains each day.	**Never**	**Sometimes**	**Often**	**Routinely**
10.	Take part in strengthening activities (such a resistance bands or heavy gardening) 2 or more times a week.	**Never**	**Sometimes**	**Often**	**Routinely**
11.	Accept those things in my life which I can not change.	**Never**	**Sometimes**	**Often**	**Routinely**
12.	Look forward to the future.	**Never**	**Sometimes**	**Often**	**Routinely**
13.	Eat at least 2.5 cups (2-5 servings) of fruit each day.	**Never**	**Sometimes**	**Often**	**Routinely**
14.	Take part in leisure-time (recreational) physical activities (such as swimming, dancing, bicycling).	**Never**	**Sometimes**	**Often**	**Routinely**
15.	Concentrate on pleasant thoughts at bedtime.	**Never**	**Sometimes**	**Often**	**Routinely**
16.	Feel content and at peace with myself.	**Never**	**Sometimes**	**Often**	**Routinely**

Appendix L

Older Person's Quality of Life Scale (OPQOL)

CONFIDENTIAL   **SERIAL NO.** ☐ ☐ ☐ ☐

Older People's Quality of Life Questionnaire (OPQOL-35)

We would like to ask you about your quality of life:
Please tick one box in each row. There are no right or wrong answers. Please select the response that best describes you/your views.

1. Thinking about both the good and bad things that make up your quality of life, how would you rate the quality of your life as a whole?

Your quality of life
as a whole is: Very good   Good   Alright   Bad   Very bad

(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

2. **Please indicates the extent to which you agree or disagree with each of the following statements.**

Tick one box in each row

Life overall

(1) **I enjoy my life overall**   Strongly   Agree   Neither agree   Disagree   Strongly
                                       agree   or disagree   disagree
                                        (1)   (2)   (3)   (4)   (5)

☐	☐	☐	☐	☐

(2) **I am happy much of the**   Strongly   Agree   Neither agree   Disagree   Strongly
      time   agree   or disagree   disagree
                                        (1)   (2)   (3)   (4)   (5)

☐	☐	☐	☐	☐

(3)   I look forward to things

                                      Strongly   Agree   Neither agree   Disagree   Strongly
                                       agree   or disagree   disagree

                                        (1)   (2)   (3)   (4)   (5)

☐	☐	☐	☐	☐

(1) **Life gets me down**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

Health (wt 4)

(2) **I have a lot of physical energy**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(3) **Pain affects my well-being**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(4) **My health restricts looking after myself or my home**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly **me** disagree (5)
☐	☐	☐	☐	☐

(5) **I am healthy enough to get out and about**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

Social relationships (wt 8)

(6) **My family, friends or would help me if needed**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly **neighbours** disagree (5)
☐	☐	☐	☐	☐

(7) **I would like more companionship or contact with other people**

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(8) **I have someone who gives me love and affection**

Strongly agree	Agree (1)	Neither agree or disagree (2)	Disagree (3)	Strongly disagree (4) (5)
☐	☐	☐	☐	☐

(12) **I'd like more people to enjoy life with**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(13) I have my children around which is important

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

Independence, control over life, freedom (wt 3)

(14) **I am healthy enough to have my independence**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(15) I can please myself what I do

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(16) **The cost of things to my pension/** agree **compared income restricts my life**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(17) **I have a lot of control** the important things **over** in my life

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

Home and neighbourhood (wt 4)

(18) **I feel safe where I live**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(19) The local shops, services and facilities are good overall

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(20) I get pleasure from my home

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(21) I find my neighbourhood friendly

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

Psychological and emotional well-being (wt 4)

(22) I take life as it comes and make the best of things

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(23) I feel lucky compared to most people

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(24) I tend to look on the bright side

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

(25) If my health limits social/ leisure activities, then I will compensate and find something else I can do

Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
☐	☐	☐	☐	☐

Financial circumstances (wt 3)

(26) **I have enough money to pay for household bills**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(27) **I have enough money to pay for household repairs or help needed in the house**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(28) **I can afford to buy what I want to**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(29) **I cannot afford to do things I would enjoy**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

Leisure and activities (wt 6)

(30) **I have social or leisure activities/hobbies that I enjoy doing**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(31) **I try to stay involved with things**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(32) **I do paid or unpaid work activities that give me a role in life**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(33) **I have responsibilities to others that restrict my social or leisure activities**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)
☐	☐	☐	☐	☐

(26) **Religion, belief philosophy is important to my quality of life**	Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly **or** disagree (5)
	☐	☐	☐	☐	☐

(35) **Cultural/religious events/festivals are important to my quality of life**	Strongly agree (1)	Agree (2)	Neither agree or disagree (3)	Disagree (4)	Strongly disagree (5)
	☐	☐	☐	☐	☐

Thank you for your help.

Appendix M

Existing Study (LEAP!) Protocol

Existing Study (LEAP!) Protocol

Education Curriculum

  In 2015, The University of Kansas Alzheimer's Disease Center (KU ADC) developed a curriculum aimed at reducing risk factors for AD in cognitively normal adults, closely adhering to standard public health recommendations.[33] This curriculum, called LEAP! (Lifestyle Empowerment for Alzheimer's Prevention), utilizes current research to provide practical lifestyle strategies linked to AD risk reduction. The curriculum materials include a LEAP Smart Aging manual, numerous handouts on AD, AD risk-reduction strategies and healthy lifestyle behaviors, research highlights, PowerPoint presentations and interactive activities associated with each lifestyle behavior. The curriculum was piloted and revised based on input from cohorts at senior living communities and community forums in the Kansas City metropolitan area.

  Curriculum materials, most notably those referencing community resources, were modified to apply to the rural communities represented in this study. Lecture, small group discussion and interactive activity formats were incorporated into each weekly workshop. These sessions provided background information on AD, AD risk, exercise and cognitive function, trends in rural Kansas/America, current research, exercise modalities and other related topics. Participants received a number of handouts and educational resources in addition to the LEAP Manual throughout the course of the study. For this project, the curriculum was organized into 8 chapters (Table 1) and included evidence-based information and recommendations on each of the modifiable lifestyle behaviors found to impact individual risk for AD. These material from these 8 chapters was taught over the course of 10 weeks.

Exercise Curriculum:

  The exercise curriculum was based on a combination of standard public health recommendations and previously published research.[21,22,23-33] Each exercise session included a 5-minute warm-up, cardiovascular exercise, resistance training exercises, and a 5 minute cool-down. Cardiovascular exercise were performed on one of the following: 160m indoor walking/jogging track, treadmill or elliptical trainer. Participants were trained to use a modified RPE scale to assess their intensity level. During the first week of training, participants performed 60 minutes of cumulative cardiorespiratory exercise (20 minutes per session) and two sets of eight repetitions on a variety of resistance training exercises (strength exercises). Both cardiorespiratory and strength training components of the exercise sessions gradually increased in volume, peaking by week 8 with 108 minutes of cardiorespiratory exercise and three sets of ten repetitions on each strength exercise. Strength exercises incorporated into this program were those previously associated with cognitive function and/or brain volume. Modifications were provided for all exercises and each participant was progressed as individual technique and fitness level allowed.

Treatment Arms

Education Group (ED):

Participants in the E group received a Garmin Vivofit 3 device, the LEAP manual, weekly group education sessions and were encouraged to increase physical activity levels. Education sessions were 70-90 minutes in duration and were taught by the principal investigator. While physical activity and exercise were encouraged, no in-person exercise training was provided. Physical activity tracking devices were synced each week during the education session to allow the research team to track physical activity levels of each participant.

Participants were required to attend at least 8 of the 10 educational sessions.

Education + Exercise Group (EDEX):

EDEX participants participated in weekly group exercise in addition to attending the weekly education sessions. Exercise sessions for the EDEX group were led by the principal investigator and assisted by student interns who completed competency-based evaluations. EDEX participants were expected to exercise in a semi-group format three times each week. Personalized exercise logs were provided for each participant each week.

In order to accommodate the many schedules of participants, six exercise sessions were offered. Participants were allowed to exercise during any of the available, non-consecutive sessions, allowing a minimum of 24 hours between exercise bouts. Participants who planned to miss an exercise session(s) due to travel were provided with an exercise training document to use while out of town. EDEX participants were required to attend 8 of the 10 weeks of exercise sessions. Participants were informed that extended (>2 absences from education or >6 absences from exercise) would result in removal from the study.

Control Group (CON):

Participants randomized to the CON group were given a physical activity tracking device (Garmin Vivofit 3), the LEAP! Manual and told to contact the principal investigator with any questions throughout the study period. Participants in this group were asked to meet a member of the research team every few weeks to sync their physical activity tracking device. Aside from baseline and post-intervention assessment and this interaction, CON participants did not participate in any additional study procedures and were encouraged to continue their normal daily activities. They were not asked to engage in any activity beyond what they were normally accustomed to.

Appendix N

Participant Interview Questionnaire

Physical Activity & Exercise Questions

Gender: _____ (Male / Female)

Age: _____

Research Group: _____ (Control / Education / Education + Exercise)

Thank you so much for taking the time to answer the following questions. Your feedback is important and helps us better understand how to design effective, affordable education and exercise programs for communities in the Flint Hills Region!

If you have any questions, please do not hesitate to contact me!

Erin Blocker
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1. Describe your typical day. What do you do on a regular basis that keeps you active?

2. Why is physical activity/exercise important?

3. In your own words, describe the difference between physical activity and exercise?

4. Do you feel like there are opportunities available to you to participate in physical activity / exercise?

5. Please list the potential barriers that might/do prevent you from exercising.

6. Please list the potential barriers that might/do prevent you from participating in physical activity.

Additional thoughts, feedback, questions.