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Visual Acuity's Association with Levels of Leisure-Time Physical Activity Among Community-Dwelling Older Adults

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Abstract

Little is known about the affect of reduced vision on physical activity in older adults. This study evaluates the association of visual acuity level, self-reported vision and ocular disease conditions with leisure-time physical activity and calculated caloric expenditure. A cross sectional study of 911 subjects 65 yr and older from the University of Alabama at Birmingham Study of Aging (SOA) cohort was conducted evaluating the association of vision-related variables to weekly kilocalorie expenditure calculated from the 17-item Leisure Time Physical Activity Questionnaire. Ordinal logistic regression was used to evaluate possible associations controlling for potential confounders. In multivariate analyses, each lower step in visual acuity category below 20/50 was significantly associated with reduced odds of having a higher level of physical activity OR 0.81, 95% CI 0.67, 0.97. Reduced visual acuity appears to be independently associated with lower levels of physical activity among community-dwelling adults.

Keywords

kilocalorie; low vision; older adults

Introduction

The aging of the baby boom population in the United States is expected to result in a doubling of the number of older adults living with blindness and visual impairment over the next 30 years (Prevent Blindness America Foundation, 2008). Numerous studies have shown that older adults with diminished visual acuity have lower performance on selected activities of daily living (ADL's) and instrumental activities of daily living (IADLs; Berger & Porell, 2008; Swanson, & McGwin, 2004; West, et al., 2002). Reduced visual acuity has also been associated with a number of adverse health outcomes for older adults, including an increased risk of five-year mortality, increased risk of nursing-home placement, increased risk of hip fracture, and an increase in the length of hospital stays (Aditya, Sharma, Allen, & Vasallo, 2003; Cacciatore et al., 2004; Ivers, Cumming, Mitchell, Simpson, & Perduto, 2003; Morse, Yatzkan, Berberich, & Arons, 1999). Exactly how visual impairment affects these outcomes is not well understood.

Leisure-time physical activity is a construct used to describe participation in both lifestyle activities (chores, gardening, etc.) and more traditional exercise. Self-assessment scales for

leisure-time activity were developed in the 1960's. Since that time higher levels of leisure-time physical activity have been associated with reductions in all cause mortality, coronary heart disease, cancer incidence, falls, and physical disability (Ferrucci et al., 1999; Gregg, et al., 2003; Gregg, Pereira, & Caspersen, 2000; Wannamethee, Shaper, & Walker, 1998). Little is known about the impact of vision on leisure-time physical activity among older adults. Baltes has theorized that reduced vision may play a key role in expanded competencies and participation in discretionary leisure activities by older adults (Marsiske, Klumb, & Baltes, 1997). In this study we evaluate the association of visual acuity worse than 20/50 and less than 20/80 on total kilocalorie expenditure estimated by the Leisure Time Physical Activity Questionnaire (LTPAQ). In secondary analyses we evaluate associations between self-reported vision, untreated cataracts, and glaucoma and kilocalorie expenditure.

Methods

Study Design and Participants

This study presents an analysis of data available from the baseline assessment of participants in the University of Alabama at Birmingham Study of Aging (SOA) to examine the association between visual acuity and leisure-time physical activity among community-dwelling older adults. A more complete description of the SOA sample methodology is found elsewhere (Baker, Bodner, & Allman, 2003), but, in brief, the SOA is a community-based longitudinal study of 1,000 Medicare beneficiaries aged 65 and older with enrollment beginning in December 1999. The principal focus of the study was to understand factors associated with life space mobility. SOA participants were recruited from five counties in central Alabama. Two counties were urban and in the Birmingham Metropolitan Statistical Area, and three counties were rural as classified by the Alabama Rural Health Association (Baker et al., 2003).

Letters were sent to 3,100 Medicare beneficiaries, identified from county lists provided by the Centers for Medicare and Medicaid Services to inform them of the study. Letters were followed by telephone calls to invite participation in an in-home interview. One thousand subjects, representing a stratified, random sample over-sampling males, African-Americans, and rural residents were enrolled; this was 46% of all those contacted by telephone. Nursing-home residents and those unable to schedule their own appointments were excluded.

The current study involves an analysis of data from 911 participants in SOA with LTPAQ data who also completed a self-assessment of visual status. Participants from the SOA who were unable to stand during the in-home assessment were excluded ($n=89$). Of the 911 participants with LTPAQ data, 893 (98.0%) completed in-home visual acuity testing. This research project was approved by the University of Alabama at Birmingham institutional review board.

Data Collection and Variable Definitions

After obtaining informed consent, trained research staff conducted an in-home evaluation that included an interview that lasting approximately 2 hr, as well as direct assessment. Data collected included demographic information, diseases and conditions, neuropsychological factors, geriatric syndromes, psychosocial factors, self-reported activity, and performance based measures including visual acuity.

The LTPAQ, a modification of the Minnesota Leisure Time Physical Activity Assessment, has been used to estimate caloric expenditure over the week before an assessment (Siscovick et al., 1997; Taylor et al., 1978). The LTPAQ battery includes questions about the frequency and duration of 17 different types of activities (walking, household chores, mowing, raking, gardening, hiking, jogging, biking, exercise cycling, dancing, aerobics and water aerobics,

bowling, golfing, general exercise, swimming, tennis, and racquetball). Items in the survey include activities shown to be those in which older adults are most likely to participate (McPhillips, Pellettera, Barrett-Connor, Wingard, & Criqui, 1989). The LTPAQ has been used extensively and validated indirectly against treadmill performance (Jacobs, Ainsworth, Hartman, & Leon, 1993) and doubly labeled water energy expenditure (Conway, Irwin, & Ainsworth, 2002). To calculate caloric expenditure all activities from the LTPAQ were assigned metabolic equivalents (estimated $\text{ml O}_2 \cdot \text{kg of body weight}^{-1} \cdot \text{min}^{-1}$: METs) according to the methods described by Martin, Powell, Peel, Zhu, & Allman, (2006). The number of sessions and duration of leisure activity reported over a 2-week period were then converted to a weekly estimate adjusted for body weight.

Distance visual acuity was measured in each eye with habitual refractive correction using the Early Treatment of Diabetic Retinopathy Study chart with measurement in log of the minimum angle of resolution units (Ferris, Kassoff, Bresnick, & Bailey, 1982). Early Treatment of Diabetic Retinopathy charts using log of the minimum angle of resolution units are the gold standard in ophthalmic research and have many design advantages over traditional Snellen charts. Using these charts visual acuity can be measured as a true continuous variable while allowing for conversion to the more familiar Snellen fraction. The assessment was given in the best lighting possible in participant homes to approximate usual reading conditions.

Subjects were also asked four questions related to vision self-assessment. Self-assessed visual impairment was coded as present from a positive response to any of the following four questions. Wearing your glasses or contact lenses if you have them, do you have difficulty with any of the following tasks:

- (1) Reading a large-print book or large print newspaper or numbers on a telephone?
- (2) Recognizing people when they are close to you? (3) Seeing steps stairs, or curbs? (4) Reading traffic signs, street signs, or store signs?

Responses from the baseline SOA interview were used to control for a variety of potential confounders. The 15-item version of the Geriatric Depression Scale (Sheikh & Yesavage, 1986) was administered, and a dichotomous variable was created with depression considered to be present if five or more depressive symptoms were reported. A validated co-morbidity count was developed based on items in the Charlson Comorbidity Index (MacKenzie, Charlson, DiGioia, & Kelley, 1986), including congestive heart failure, myocardial infarction, valvular heart disease, peripheral artery disease, hypertension, diabetes, chronic obstructive pulmonary disease, kidney failure, liver disease, non-skin cancer, neurological disease and gastrointestinal disease, without consideration of severity of the conditions. A condition was considered validated if the subject reported taking a medication for it, if the subject's primary physician returned a questionnaire indicating that the participant had the disease, or if a hospital discharge summary for a hospitalization in the previous 3 years listed the condition. The validated comorbidity index was converted to a three level categorical variable of no comorbidities, one comorbidity, or two or more comorbidities.

Cognitive status was assessed using a standardized questionnaire with scores ranging from 0 to 30 (Folstein, Robins, & Helzer, 1983), with higher scores indicating better cognitive function. Pain was noted as present if the subject had reported any pain in the month before the in-home assessment. Participants were asked to show all medications they used to the interviewer, who calculated the number of prescription medications. Educational attainment was evaluated as a dichotomous variable of less than high school and high school or greater. Body-mass index (BMI) as a continuous variable was calculated from direct measures of height and weight taken during the in-home assessment for participants able to stand, with the exception of 37 participants who had BMI calculated from self-reported height and

weight. BMI for those unable to stand and therefore excluded from this analysis was calculated by a knee-height measure and arm circumference.

Statistical Analysis

Visual acuity was converted to Snellen equivalents, and acuity in the better eye used for analysis purposes. Better visual acuity has been shown to be highly correlated with binocular visual acuity and performance on daily activities including reading and face recognition (Rubin, Munoz, Bandeen-Roche, & West, 2000). Visual acuity was categorized into four levels: 20/50, >20/50 to 20/80, > 20/80 to 20/180, and >20/180. Visual acuity less than 20/80 in the better eye is a common criterion for visual impairment in the United States. Visual acuity of 20/50 is frequently used as a criterion threshold for legal driving, is used by federal agencies for visual impairment reporting, and is recognized as a level at which vision begins to affect daily activities. (National Eye Institute, 2010; Rubin et al., 2000) Because of the limited numbers of subjects with high levels of visual impairment (>20/180), a second variable was created with visual acuity collapsed into a dichotomous measure of those with 20/80 or better and those with worse than 20/80 Snellen equivalent. These categories correspond to commonly used ranges for visual impairment classification. By convention, greater Snellen denominator values associated with worse visual acuity. Kilocalorie-per-week expenditures were categorized into five levels based on the recommendations of Martin et al. (2006). Levels were 0, 1–400, 401–1000, 1001–1800, and >1800 kcal/wk and approximate the quintile distributions.

Chi-square and analysis of variance was used to evaluate differences between included and excluded subjects. Ordinal logistic regression was used to evaluate the relationship of visual acuity to kilocalorie expenditure category. Ordinal model validity was assessed using $-2\log$ likelihood and assumption of parallel lines evaluated with chi-square testing for each equation. Primary analyses evaluated the association of the independent variable four-category or two-category visual acuity to the dependent variable kcal/week-expenditure category, controlling for confounding by age, gender, race, education, location, BMI, Geriatric Depression Scale score, cognitive status score, validated comorbidity index, and number of medications taken. In secondary analyses, the association of glaucoma, untreated cataract and self-reported poor vision with kilocalorie-expenditure category was assessed in separate analyses controlling for the same confounders. Odds ratios were calculated for all vision variables using the polytomous universal model in SPSS version 15 (Chicago, Ill) with the method described by Norusis (2008). Level of statistical significant was $p<.05$ (two-tail) for all analyses.

Results

Table 1 summarizes the characteristics of the 911 study participants. In accordance with the SOA design approximately half were African Americans and half were rural, and all were aged 65 years or older. As would be expected, the excluded subjects ($n=89$), who were unable to stand or had incomplete LTPAQ data, were significantly different from the included subjects. Excluded subjects had lower levels of kilocalorie expenditure, $F(1,987)=12.82$, $p<.001$; were older, $F(1,1000)=12.81$, $p<.001$; had lower cognitive status scores, $F(1,1000)=73.32$, $p<.001$; were taking more medication, $F(1,1000)=9.97$, $p=.002$; had greater numbers of depressed responses, $F(1,1000)=30.65$, $p<.001$; were more likely to be African American, $\chi^2(1,1000)=22.81$; $p<.001$, and had lower levels of educational attainment, $\chi^2(1,1000)=29.62$, $p<.001$; higher numbers of comorbid conditions, $\chi^2(1,1000)=15.57$, $p<.001$; and higher prevalence of glaucoma, $\chi^2(1,1000)=10.20$, $p=.002$, and were more likely to have poorer visual acuity $\chi^2(1,1000)=22.81$, $p<.001$.

Visual acuity in the better eye ranged from 20/20 to 20/800 Snellen equivalent. As expected in a population-based study, visual acuity was skewed towards better vision, with over 90% (809/893) of subjects having visual acuity better than 20/80 and 59% (524/893) having acuity better than 20/50. Legal blindness, defined in the United States as acuity of 20/200 or worse in the better eye, was found in 1% (9/893) of subjects. Poor vision was reported by 15% (138/911) of subjects. Self-reported poor vision while showing a statistically significant association, was weakly correlated with measured visual acuity, $r=.29$, $n=893$, $p=.01$. The relatively high prevalence of self-reported glaucoma and untreated cataracts is not unexpected based on the age and racial makeup of the subject population.

Strenuous household chores and gardening were the most common leisure-time physical activities the cohort reported participating in during the year before the baseline evaluation (Table 2). Reported participation rates for those with poor acuity were lower than the overall cohort for all activities except walking for exercise. Walking for exercise and strenuous house chores were the most common activities for those with poor visual acuity, $>20/80$. Leisure-time physical activity and resultant weekly kilocalorie expenditure was low for the entire group. Weekly kilocalorie expenditure based on the 2-week LTPAQ estimates ranged from 0–24,944 kcal/week, with a mean of 1793 kcal/week. Several extreme values of kilocalorie expenditure were calculated, skewing the mean and variance. Quartile levels for the 25th, 50th, and 75th percentiles of kilocalorie expenditure were 154.5, 777.6, and 1203.3 kcal/week, respectively. Overall 78% (714/911) of subjects had less than 1,800 kcal/week energy expenditure, and 68% (283/911) had less than 1,600 kcal/week. Among subjects with visual impairment ($>20/80$), 89% (9/84) had less than 1,800 kcal/week expenditure, compared with 77% (186/809) among those with better than 20/80 acuity (Table 3). The percentage of subjects with $>20/80$ acuity reporting no leisure-time physical activity was more than double that of those with $\leq 20/80$ acuity. As visual acuity category increased from 20/50 to $>20/180$ the percentage of subjects reaching either 1,600 or 1,800 kcal/wk expenditure levels decreased (Table 4).

In evaluating statistical associations the assumption of parallel lines was not violated in any equation, indicating reasonable ordinal models. Visual acuity as a four- or two- category measure (higher acuity category), depression, increased number of medications, and older age were associated with lower levels of kilocalorie expenditure category controlling for other confounders. Each increase in level of visual acuity (four categories) was associated with a 19% decreased odds, of being in the next higher kilocalorie-expenditure level (Table 5). Those with $>20/80$ acuity (two-category visual acuity) had 46% decreased odds, $\chi^2(1,893)=8.49$, $OR=.54$, 95% CI 0.36,0.82, for having higher kcal/week category. In independent models controlling for all confounders glaucoma, $\chi^2(1,911)=0.37$, $OR=1.29$, 95% CI 0.90,1.87; untreated cataracts, $\chi^2(1,911)=0.37$, $OR=0.91$, 95% CI 0.68,1.22; and self-reported poor vision, $\chi^2(1,911)=0.56$, $OR=1.14$, 95% CI 0.81,1.52, were not associated with kilocalorie-expenditure category.

Discussion

Physical activity as it relates to health benefits has been divided into three components: leisure-time activity, commuting activity, and occupational activity (Hu et al., 2004). For older adults, leisure-time activity constitutes the bulk of overall physical activity contributing to health benefits (Hu et al., 2004). Leisure-time physical activity has been shown to not only affect health-related outcomes for older adults but improve cognitive function and depressive symptoms (Papa, Reynolds, & Small, 2009; Teychenne, Ball, & Salmon, 2008). Our results indicate that older adults with lower levels of visual acuity have reduced levels of leisure-time physical activity and an overall reduction in caloric expenditure, even after controlling for potential health-related confounders. The decrease in

caloric expenditure was demonstrated with a relatively modest reduction in visual acuity below the 20/50 level in the better-seeing eye.

Participation in leisure-time physical activity has been shown to have a dose-response effect on health benefits (Lee, Hsieh, & Paffenbarger, 1995; Leon & Connett, 1991). Current recommendations for older adults from the U.S. Department of Health and Human Services (USDHHS, 2009) call for a minimum of 150 minutes of moderate-intensity aerobic exercise per week. Results from the landmark Multiple Risk Factor Intervention Trial and the Harvard Alumni Cohort Study indicate that this level of physical activity equates to approximately 1,600–2,000 kcal/week of energy expenditure (Lee et al., 1995; Leon & Connett, 1991). Less than a quarter of the SOA cohort had this level of energy expenditure from leisure-time physical activity. These findings are consistent with data from the Behavioral Risk Factor Surveillance Survey (Centers for Disease Control and Prevention, 2009) which indicate that only about 32% of older adults in Alabama meet national guidelines. For subjects with visual impairment > 20/80, only 10% met these minimal criteria for leisure-time physical activity. Visual acuity may be an important marker of those at risk for no physical activity. More than 2 times the number of subjects with visual impairment >20/80 had no leisure-time physical activity compared to non-visually impaired subjects.

Previous studies examining the impact of vision on physical activity have concentrated on how specific eye diseases or vision measures (acuity, contrast sensitivity, visual fields) affect the performance of individual ADLs, IADLs, and mobility tasks (walking, timed walking, climbing stairs), and the outcomes of falls or fear of falling (Klein, Klein, Knudtson & Lee, 2003; Klein, Moss, Klein, Lee, & Cruickshanks, 2003; West et al., 1997). Our results are consistent with those studies in showing that relatively modest vision loss affects function. Studies specifically looking at visual acuity and kilocalorie expenditure in physical activity have not been performed, but Roth, Goode, Clay, & Ball (2003) found that useful field of view, a speed of visual processing and divided attention task, is associated with overall activity level measured by both an exercise-specific and a more global activity instrument. Visual acuity was not specifically addressed in their study. Visual acuity has, however, been found by factor analysis to load onto useful field of view (Owsley, 1994).

Glaucoma, cataract, and self-reported poor vision were not found to be associated with leisure-time physical activity caloric expenditure. Glaucoma and cataract have been shown to be associated with decreased mobility and increased falls (Ivers, Cumming, Mitchell, & Attebo, 1998; Ramula, 2009). In the current study both conditions were self-reported, and whether one or both eyes were affected was unknown. Overlapping loss of monocular visual field in glaucoma is important in affecting functional abilities (Ramula 2009). It is possible that the degree of overlapping visual field loss among those reporting glaucoma was insufficient to produce any functional effect. Although the presence of cataract has been found to be associated with falls, results from studies looking at falls reduction and mobility increase after cataract surgery have been mixed (Elliott, McGwin, & Owsley, 2009; McGwin, Gewant, Modjarrad, Hall, & Owsley, 2006). The only study to directly evaluate physical activity and cataracts, that of Paunsknis, Kusleika, and Kusleikaite (2006), found an association between cataract density and METs per week. This study was, unfortunately, limited by not controlling for potential confounding factors.

In addition to the identified association with visual acuity, many other associations with lower levels of leisure-time physical activity and caloric expenditure are well documented. Older age, non-White race, gender, rural location, lower education, increased BMI, poor health status, depression and lower self-efficacy have all been found to be associated with lower leisure-time physical activity (Eyler, 2003). Age, presence of depression, and the

number of medications used were found to be associated with LTPAQ results, while other key demographic factors (race, gender, locale, education) were not significant in our study. This may have been because of the older age of the cohort than in most leisure-time physical activity studies, which include large numbers of middle-aged adults. In addition, the individual items in the LTPAQ reflect a broader definition of physical activity than the more narrow exercise or sports-only items used in some studies. This broad definition of leisure-time physical activity by the LTPAQ captures activities in which older adults including those with visual impairment are likely to participate.

As with any community-based study, ours has strengths and weaknesses. The large sample size makes it unlikely that chance played a significant role in our results. The SOA, although not a purely random sample, does appear to be reflective of the study communities, indicating no significant recruitment bias. The rates of visual impairment and the amount of leisure-time physical activity reported are consistent with data from other sources. As would be expected from a community-based study the rates of severe visual impairment are low. The use of broader categories describing visual acuity and visual impairment addresses this issue. Recall bias is always a concern with studies of older adults, and the cohort does include persons with cognitive-status scores consistent with some impairment or low levels of educational attainment; however, 98% of the participants had cognitive status scores that others have found permit accurate reports of health status (Brod, Stewart, Sands, & Walton, 1999; Logsdon, Gibbons, McCurry, & Teri, 2002).

All the measurement instruments used in the SOA are well validated and widely accepted in older adult populations (Ashe, Miller, Eng, & Noreau, 2009; Ferris et al., 1982; Folstein et al., 1983; Jamison, Raymond, Slawsby, McHugo, & Baird, 2006; MacKenzie et al., 1986; Sheikh & Yesavage, 1986; Siscovick, et al., 1997; Taylor et al., 1978) For the main outcome measure, caloric expenditure as derived from the LTPAQ, some degree of over- and underreporting of activity is likely inevitable. However, there is no reason to believe that misclassification was biased in either direction. Concern about over reporting of leisure-time physical activity at the highest levels was controlled for in the analysis using an ordinal regression model.

There are limitations which must be acknowledged. The study population includes no minorities other than African Americans, and the results may not extend to other ethnic groups. Visual acuity was the only vision-related measure included in the SOA, and the confounding role that contrast sensitivity, visual field loss, and other vision factors may have played is unknown. As with any cross-sectional study the direction of the association is unknown, leading to the key questions “Does reduced physical activity lead to reduced vision?” and “Does reduced vision lead to reduced physical activity?” Kulmala et al. (2008) suggest that the relationship of visual acuity and mortality risk factors may be bidirectional. Further studies are needed clarify this issue.

Physical activity clearly plays a key role in maintaining the health and well-being of older adults. To our knowledge this is the first large community-based study to show that reduced visual acuity in older adults is associated with lower overall leisure-time physical activity and kilocalorie expenditure. Current guidelines from the USDHHS (2008) call for 150 minutes of moderate to vigorous physical activity per week for older adults and for those with disabilities, regardless of disability type. Our results suggest that older adults with even modest levels of visual impairment may not reach this threshold.

Healthy People 2020 (USDHHS 2010), in a new target for older adults, set a goal of a 10% improvement in the number of people participating in moderate physical activity. Vision appears to be a largely overlooked contributor to low levels of physical activity participation

for this age group. Uncorrected refractive error and cataracts are two important and correctable causes of vision loss which warrant study for the potential in improving physical activity participation. Those with poorer vision have broadly lower participation rates in the gamut of LTPAQ activities except walking for exercise. From the current data we are unable to determine other factors that may have led to low leisure-time physical activity among those with impaired vision. Task-specific issues, lack of transportation, poor self-efficacy, or environmental issues (e.g., no walking paths) may play some role and need to be investigated. For older adults with permanent visual impairment, the need for vision-level-appropriate physical activity plans need to be further studied.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Participant Characteristics, N=911

	n (%)	M (SD)	Range
Race			
White	477(52.4)		
African American	434(47.6)		
Gender			
Female	450(49.4)		
Male	461(50.6)		
Education			
High school	183(20.1)		
< High school	728(79.9)		
Locale			
Rural	465(51.0)		
Urban	446(49.0)		
Any reported pain	667(73.2)		
Comorbidity Index			
0	111(12.2)		
1	242(26.6)		
2 or more	558(61.3)		
Glaucoma	107(11.8)		
Untreated cataract	187 (20.5)		
Self-reported poor vision	138 (15.2)		
Visual acuity			
20/50	524 (58.7)		
>20/50 – 20/80	285 (31.9)		
>20/80 – 20/180	65 (7.3)		
>20/180	19 (2.1)		
Age, Years		75.1 (6.5)	65–97
Cognitive Status score ^a		25.4 (4.5)	5–30
Geriatric Depression Scale score ^b		2.2 (2.2)	0–14
Number of Prescription Medications		4.2 (3.2)	0–18
Body-mass index		27.8 (6.2)	15–108
Leisure-time physical activity (Kcal/wk)		1738.4 (2791.2)	0–24,943
0	161 (17.7)		
1–400	173 (19.0)		
401–1,000	180 (19.8)		
1,001–1,800	200 (22.0)		
>1,800	197 (21.6)		

Note. Participants with measured visual acuity =893.

^aHigher scores indicate better cognitive function.

^b Higher scores indicate a higher number of depressed responses.

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Table 2

Leisure-Time Physical Activity Participation in the Previous Year, n (%)

Activity	Total Population, N=911	Visual Acuity>20/80, N=84
Moderately strenuous household chores	583 (64.0)	31(36.9)
Gardening	577 (63.3)	18(21.4)
Walked for exercise	534 (58.6)	50(59.5)
Mowed the lawn	374 (41.1)	23(27.4)
Raked the yard	296 (32.5)	20(23.8)
General exercise	277 (30.4)	16(19.0)
Exercise cycling	103 (11.3)	5(6.0)
Dancing	35 (3.8)	2(2.4)
Swimming	34 (3.7)	1(1.2)
Golf	21 (2.3)	1(1.2)
Hiking	21 (2.3)	1(1.2)
Biking	15 (1.6)	0
Aerobics	18 (2.0)	0
Bowling	8 (0.9)	0
Jogging	7 (0.8)	0

Table 3

Visual Impairment and Weekly Kilocalorie Expenditure, n (%)

Kilocalorie expenditure (per week)	Visual acuity 20/80	Visual acuity >20/80	Total
0	126 (15.6)	27 (32.1)	153(17.1)
1–400	152 (18.8)	17 (20.2)	169(18.9)
401–1,000	162 (20.0)	17 (20.2)	179(20.0)
1,001–1,800	183 (22.6)	14 (16.7)	197(22.1)
>1,800	186 (23.0)	9 (10.7)	195(21.8)
Total	809	84	893

Table 4

Visual Acuity and Healthy Kilocalorie Expenditure Targets

Visual acuity	1,600 kcal/week, n (%)	1,800 kcal/week, n (%)	Total, n
20/50	186(35)	127(24)	524
>20/50– 20/80	79(28)	59(21)	285
>20/80– 20/180	16(24)	8(12)	65
>20/180	2(10)	1(5)	19
Total	283(32)	195(22)	893

Table 5

Association of Visual Acuity and Leisure-Time Physical Activity, N=893

Variable	Wald χ^2	95% CI		
		OR		p
Age	12.88	0.96	0.94–0.98	.03
Race	2.98	1.26	0.96–1.66	.08
Gender	1.52	1.16	0.91–1.47	.21
Residence	1.81	0.95	0.67–1.09	.18
Education	1.76	1.03	0.99–1.08	.16
Depression	12.12	0.90	0.85–0.95	<.001
Medications	10.54	0.93	0.89–0.97	.001
Cognitive-status score	0.09	1.01	0.97–1.04	.76
Comorbidity index	3.15	0.85	0.71–1.03	.08
Pain	0.03	1.02	0.78–1.35	.86
Body-mass index	0.07	1.00	0.98–1.02	.79
Visual acuity	5.50	0.81	0.69–0.97	.02

Note. Age, medications, cognitive-status score and body-mass are continuous measures. Comparison population for race is White. Comparison gender is male. Comparison population for residence is rural. Comparison population for education is < high school. Comparison population for depression is absent. Comparison population for any pain is absent. Comparison population for four category visual acuity is 20/50.