Published in final edited form as:

Maturitas. 2017 February ; 96: 33–38. doi:10.1016/j.maturitas.2016.11.009.

Visual Impairment at Baseline is Associated with Future Poor Physical Functioning Among Middle-Aged Women: The Study of Women's Health Across the Nation, Michigan site

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Abstract

Objectives—Emerging evidence suggests that the prevalence rates of poor functioning and of disability are increasing among middle-aged individuals. Visual impairment is associated with poor functioning among older adults but little is known about the impact of vision on functioning during midlife. The objective of this study was to assess the impact of visual impairment on future physical functioning among middle-aged women.

Study design—In this longitudinal study, the sample consisted of 483 women aged 42 to 56 years, from the Michigan site of the Study of Women's Health Across the Nation.

Main Outcome Measures—At baseline, distance and near vision were measured using a Titmus vision screener. Visual impairment was defined as visual acuity worse than 20/40. Physical

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Contributors

NC conducted the statistical analysis, participated in the interpretation of data, and drafted the article.

SH contributed to the conception and design of the study, interpretation of data, and review of the article.

SM contributed to interpretation of data and review of the article.

DM contributed to interpretation of data and review of the article.

QP contributed to the analysis and interpretation of data and review of the article

CK-G contributed to the conception and design of the study, acquisition of data, interpretation of data, and drafting and review of the article.

All authors saw and approved the final version of the manuscript.

Ethical approval

The University of Michigan Institutional Review Board approved the study protocol and written informed consent was obtained from each participant at each study visit. This study conformed to the principles of the Declaration of Helsinki.

Conflict of interest

The authors declare that they have no conflict of interest.

Provenance and peer review

This article has undergone peer review.

functioning was measured up to 10 years later using performance-based measures, including a 40-foot timed walk, timed stair climb and forward reach.

Results—Women with impaired distance vision at baseline had 2.81 centimeters less forward reach distance (95% confidence interval (CI): $-4.19, -1.42$) and 4.26 seconds longer stair climb time (95% CI: $2.73, 5.79$) at follow-up than women without impaired distance vision. Women with impaired near vision also had less forward reach distance (2.26 centimeters, 95% CI: $-3.30, -1.21$) than those without impaired near vision.

Conclusion—Among middle-aged women, visual impairment is a marker of poor physical functioning. Routine eye testing and vision correction may help improve physical functioning among midlife individuals.

Keywords

Midlife; middle-age; physical functioning; vision; visual impairment; women

1. INTRODUCTION

Visual impairment, defined as visual acuity worse than 20/40 (1), affects 14 million people in the United States and its prevalence increases with advancing age (2). Visual acuity commonly referred to as clarity of vision, is the ability to distinguish letters and numbers at a given distance. The midlife period, comprising ages 40-65 years, is an important life stage for onset and progression of poor physical functioning and disability (4, 5). In addition, visual impairment prevalence triples during this life-stage (6).

Disability, which has traditionally been described as a chain of events starting with impairment and leading to limitation before the final onset of disability, affects 47.5 million people in the United States (7, 8). It is of concern that an increasing trend of disability has been reported among midlife populations, with prevalence estimates ranging from 20-40% (5,8-10). Visual impairment is a correlate of disability and poor functioning among elderly populations (11, 12). Among older adults, visual impairment predicts a greater decline in physical functioning and slower walking speed, thus adversely affecting the quality of life and dependency (13-17).

Many ophthalmologic conditions including cataract, glaucoma, and age-related macular degeneration that affect both distance and near vision as well as presbyopia that affects near vision are commonly diagnosed during the midlife (18, 19). Yet studies of impact of visual impairment on functional decline during midlife are limited. Thus, the objective of this study was to assess the relationship of midlife visual impairment and future physical functioning. We hypothesized that women with poor visual acuity meeting the threshold for visual impairment during midlife would have poorer performance-based physical functioning during the transition to early old age.

2. METHODS

2.1 Study sample

The Study of Women's Health Across the Nation (SWAN) is a multi-site, multi-ethnic longitudinal study of the menopausal transition. Michigan is one of seven clinical sites for the study and includes a population-based sample from two Detroit-area communities identified using a community census based on electrical utility listings. Since the study's inception in 1996, the Michigan site has had a physical functioning protocol. Visual acuity was assessed from 1996-2007. The University of Michigan Institutional Review Board approved the study protocol and written informed consent was obtained from each participant at each study visit. This study conformed to the principles of the Declaration of Helsinki.

A total of 543 women were recruited to the Michigan SWAN cohort in 1996. Eligibility criteria at baseline included 42-52 years of age, having an intact uterus and at least one menstrual period in the previous 3 months, and no use of reproductive hormones in the previous 3 months (20). Retention has been excellent; after 10 years of follow-up, 86% of still-living participants were actively engaged in follow-up.

For this analysis, each woman's first vision assessment characterized baseline visual acuity. For most women, vision was assessed first in 1996 (66.1%), 1997 (28.4%), or 1998 (2.1%). Only 3.5% were assessed for vision between 1999 and 2004. Each woman's last physical functioning assessment characterized future functioning. For most women, physical functioning was assessed in 2006 (84.5%), 2005 (3.4%), or 2004 (3.4%). Follow-up visual acuity was also measured at the time of physical functioning assessment. The analytical sample for this study included 483 women with at least one vision test and one subsequent assessment for physical functioning between 1996 and 2006. The average time between vision and physical functioning assessment was 9 years and 82% of women had at least 9 years of follow-up time.

2.2 Measures

2.2.1 Vision—Visual acuity was assessed using the Titmus II vision screener, occupational model. The Titmus vision screener is a stereoscopic instrument that is widely used in occupational and school health settings to measure vision. Visual acuity was measured by presenting a self-lit slide while participant was looking through the eyepiece of the instrument. Each slide contained group of diamonds shaped figures, each containing four rings with one ring having a break in the oblique axis. The participants were asked to name the position of the ring with break. The test began by participant identifying the most easily identifiable ring and ended when two consecutive answers were missed. The instrument was designed to simulate a distance of 20 feet for distant vision measurement and 14 inches for near vision measurement. Glasses or contacts were permitted during the assessment, thus our measure of vision represented presenting visual acuity. Distance visual acuity was recorded as a fraction, with the denominator representing the distance in feet at which the participant identified the smallest shape and the numerator representing the distance at

which a normal sighted person is expected to identify the same shape. Near visual acuity was also recorded as a 'distant equivalent' fraction.

Visual impairment, the primary exposure of interest, was defined as distance visual acuity of 20/40 or worse. The same cut point (20/40) was used to define near vision impairment. This dichotomous visual impairment variable was used in all analyses. The definition of visual impairment used in this study corresponds to visual impairment criteria described by Center for Disease Control and Prevention, and is the vision requirement for obtaining an unrestricted driver's license in the State of Michigan (1, 21). Change in vision was defined as the difference between vision at the last and the first visit.

2.2.2 Physical functioning—Objective physical functioning was measured by trained staff using performance-based measures including a timed 40-foot walk (seconds), timed stair climb (seconds) and forward reach (centimeters). The physical functioning variables selected for analysis in this study were chosen a priori given the theoretical role of vision on performance.

The 40-foot walking test measured the time in seconds that elapsed while participants walked a 40 foot distance at a "brisk, purposeful pace". The timed stair climb task required participants to ascend and descend four standardized stairs three consecutive times. The time began with the toe-off of the leading leg at the start of ascent and ended with the final foot contact of the trailing leg after descent of the final cycle. Forward reach distance was measured by asking the participants to extend their dominant arm parallel to the floor while standing and reach forward the greatest distance possible while maintaining their arm in the same horizontal plane. Their reach distance was measured in centimeters as the distance between their starting point and maximum reach point.

2.2.3 Covariates—Age was calculated as date of visit minus date of birth. Race/ethnicity was self-reported as either African American or White. Level of economic strain was categorized as not at all, somewhat or very hard based on the participant's response to the question: "How difficult is it to pay for the very basics such as food, medical care, housing and heating?" Education level was categorized as less than high school, high school, more than high school, college or post-college. Height measured in centimeters (cm) and weight measured in kilograms (kg) was assessed using a stadiometer and calibrated balance beam scale respectively, and was used to calculate body mass index (BMI) in (kg/m^2). Participants were categorized as obese ($\text{BMI} \geq 30\text{kg}/\text{m}^2$) and not obese ($\text{BMI} < 30\text{kg}/\text{m}^2$).

Self-reported bleeding patterns were utilized to ascertain the participant's menopausal status. Menopausal status was categorized as postmenopausal if amenorrhea was reported for more than 12 months or if the participant had surgical removal of uterus and/or both ovaries and premenopausal if there was no report of amenorrhea for at least 12 months. Exogenous hormone use such as birth control pills, estrogen pills, injectable estrogen/progestin and progestin pills were self-reported. Smoking status was based on self-report.

Diabetes (DM) status was determined based on a self-report of doctor-diagnosed DM, fasting blood glucose ≥ 126 mg/dl and/or current use of diabetes medications. Hypertension

(HTN) was defined as self-reported doctor diagnosed HTN, use of anti-hypertensive medications, or measured systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg. Doctor diagnosed stroke, heart attack and angina were self-reported.

2.3 Statistical analysis

Continuous independent and dependent variables were examined for normality and outliers. Means and standard deviations were calculated for the outcome measures and continuous covariates including age and BMI. Frequencies and percent were tabulated for vision and categorical covariates. Covariates were identified by *a priori* knowledge, literature review and bivariate analyses. Unadjusted analyses were performed to assess the association of visual impairment at baseline with future physical functioning using linear regression. The models built in a staged progression. First, demographic covariates including age, race/ethnicity, economic strain and education were included in the model. Second, the comorbidities known to affect physical functioning including angina, DM, HTN, stroke, and arthritis were added to the model. Third, menopausal status and hormone use were added to the models given known associations with physical functioning (22, 23). All covariates were measured concurrently with physical functioning assessment. Covariates were retained in the final model if they were significantly associated with the physical functioning measures or if they changed the magnitude of the estimates for visual impairment by 10% or more. Adjusted analyses were performed using multivariable linear regression. Separate analyses were conducted for near visual impairment and distant visual impairment. To assess if baseline physical functioning confounded the analysis, baseline self-reported physical functioning was added to the models.

Effect modification by obesity status was tested by including interaction terms in the fully adjusted models. In cases where significant effect modification was demonstrated, stratified analyses were performed. Further, to examine whether vision change mediated the association between baseline visual impairment and future physical functioning, mediation analyses were performed. First, the association of change in vision and baseline vision status was examined. Then, change in vision was added to the final model to assess if it altered the estimates for baseline vision impairment by 10% or more. Statistical significance was defined as $\alpha < 0.05$. The statistical analyses were performed using SAS 9.3 (SAS institute, Cary, NC).

3. RESULTS

Of the 483 participants, 19.3% had distance vision impairment and 39.5% had near vision impairment. Among the participants with visual impairment for distance vision at baseline, 15.1% had visual acuity of 20/50, 22.6% had 20/70, 10.8% had visual acuity of 20/100 and 7.5% had 20/200 or worse. Among those with visual impairment for near vision at baseline, 19.4% had visual acuity of 20/50, 24.6% had 20/70, 13.1% had 20/100 and 4.7% had 20/200 or worse. Characteristics of the study population at the time of vision assessment are summarized in Table 1. Women with distance visual impairment were older, less educated, diabetic and postmenopausal. At first vision visit, 1.7% and 0.6% of participants reported a stroke and heart attack, respectively.

In the multi-variable analyses adjusted for age, race, economic strain, BMI, smoking, DM, HTN, stroke, heart attack, menopausal status and hormone use (Table 2), forward reach performance and timed stair climb performance was significantly poorer among women with distance visual impairment.. Women with distance visual impairment had 2.81 cm less forward reach (95% CI: -4.19, -1.42) and took 4.26 sec longer to complete the timed stair climb (95% CI: 2.73, 5.79). Further, women with distance visual impairment took 0.44 sec longer to complete the timed walk (95% CI: -0.03, 0.92) but this association did not reach the level of statistical significance. Participants with near vision impairment also had a shorter reach distance compared their non-visually impaired counterparts (2.26 cm less forward reach, 95% CI: -3.30, -1.21). Women with near visual impairment took 1.17 sec longer to climb the stairs as compared to women without near visual impairment but this association did not reach the level of statistical significance (95% CI: -0.013, 2.34). There was no association of timed walk and near vision impairment.

After additionally including baseline self-reported physical functioning in the models (Table 2, Model 3), the magnitude of the effect estimates for visual impairment and physical functioning were attenuated by 6-30% but there was no difference in statistical significance of any of the models.

Results from the mediation analysis showed that vision change was significantly associated with distance vision impairment at baseline. Women who did not have visual impairment were more likely to have a worsening of vision over the follow-up time ($P < 0.001$). After additionally adjusting for vision change in the multivariable models (Table 2, Model 4), the association of distance visual impairment with forward reach and stair climb persisted as did the association of near visual impairment with forward reach.

Obesity status exhibited significant effect modification of forward reach and distance vision impairment ($P < 0.001$) and timed walk and near vision impairment ($P = 0.002$). As shown in Figure 1, the association of distance vision impairment and forward reach was present among women with and without obesity but the magnitude of the association was slightly greater in women with obesity. As shown in Figure 2, the association of near vision impairment and timed walk was only present in women without obesity; women without obesity but with near vision impairment had 0.7 sec longer walk times compared to women without obesity or near vision impairment (95% CI: -0.01, 1.42) but there was no difference in timed walk by near visual impairment status among the group with obesity.

4. DISCUSSION

The findings of this study show that, among midlife women, visual impairment is a marker of poor physical functioning up to 10 years later. Women with distance visual impairment had 4.26 sec or 19% longer stair climb time and 2.81 cm or 6% shorter forward reach distances than women without distance visual impairment, confirming our hypothesis. Additionally, women with near vision impairment had 2.26 cm or 6.25% shorter forward reach distances. The magnitude of difference in forward reach is similar for women with distance visual impairment and those with near visual impairment underscoring the importance of both distance and near vision clarity for tasks that involve intermediate

distances straddling distant and near vision ranges. Visual impairment was associated with timed stair climb and forward reach, while timed walk did not reach statistical significance, highlighting the importance of good vision for activities involving uneven or uncertain course. Physical functioning tasks affecting postural stability, postural orientation and balance involve complex inputs from somatosensory, vestibular and visual systems. Reduced visual input among those with poor vision leads to postural imbalance and falls by compromising the vestibulo-ocular reflex (22). In our study, measures of forward reach and timed stair climb, those most affected by postural stability and postural orientation were found to be associated with visual impairment. Stair climbing and forward reach are more complex functioning tasks than is walking on a flat, stable surface. Unlike elderly populations where walking speed is associated with visual impairment (12), in this sample of middle-aged women with more mild visual impairments, it was the more complex functioning tasks that were affected by vision.

Change in visual acuity mediated the association between visual impairment and physical functioning such that participants who did not have visual impairment at first assessment were likely to have worse physical functioning at the last visit if they underwent a significant change in vision. Onset of disability or chronic impairments have implications on the psychological and mental health status of individuals, with adaptive and coping skills playing a role in adjusting to the new norm (22, 23). The negative effect of disability on mental health status is more pronounced among middle aged than older adults (23) and thus, we hypothesize that the observed effect of newer onset visual impairment leading to worse physical functioning may reflect such an adjustment period in these individuals. These findings highlight the importance of supportive care for people with new onset visual impairment as a way to attenuate its impact on functional limitations.

Models adjusting for baseline self-reported physical functioning attenuated the magnitude of the effect estimates for the association between visual impairment and performance-based physical functioning but did not change the statistical significance of any of the models. The persistent association of physical functioning and visual impairment after adjusting for baseline physical functioning is suggestive of a longitudinal association though the lack of objective physical functioning data at baseline prevents us from establishing a definitive conclusion.

With respect to obesity status, participants with obesity and distance visual impairment had worse forward reach than those without obesity. In contrast, impaired near vision was associated with longer walk time in women without obesity but not in women with obesity. This latter finding could be due to visual impairment being an important risk factor affecting physical functioning among women not already compromised in functioning by obesity or other factors, including comorbidities and pain, that play a role in worsening physical functioning among obese women.

A previous study by Lee et al. reported 20-50% decline in self-reported measures of functional status among a middle aged population with poor self-reported vision (24). Similar to Lee et al., our findings also support an association of poorer physical functioning among midlife women with visual impairment. In our analysis using performance-based

measures of physical functioning, women with visual impairment had 3-19% poorer physical functioning as compared to women without visual impairments. While our findings cannot directly be compared to the Lee et al. study given differences in methodologies for the assessment of physical functioning, the presence of an association in both studies among midlife populations supports the hypothesis that vision during the midlife is an important correlate of physical functioning. A study by Klein et al (25), consisting of midlife and elderly populations, reported no association between visual impairment and walk time which corresponds to our findings.

The cascade of events that leads to disability starts with functional deficits leading to impairment, then functional limitation and finally disability (26, 27). Our study focused on impairment and its effect on functioning while studies among elderly populations have focused on functional limitations and overt disability. By the nature of a women's health study, our study was not able to assess findings in men. Women have a higher prevalence of visual impairment as well as physical disability, warranting a gender-specific focus (8, 28). In addition, our sample consisted of only two race/ethnic groups; hence future studies with more diverse population samples would be of high interest to contribute to our understanding of the disparities in visual impairment, physical functioning and their association by race/ethnicity. As with any longitudinal study, we had some loss to follow up, but those lost to follow-up did not differ in terms of key demographics, vision status, or baseline physical functioning status as compared to women retained in the analysis. Visual acuity was tested using Titmus vision screener, which is not widely used in clinical settings. However, a validation study found that Titmus vision testing closely matched Snellen's vision testing (29) which is widely used in clinical applications. The visual acuity measured for this community-based study was presenting visual acuity and not best corrected visual acuity. Presenting visual acuity reflects the true burden of visual impairment in the community, taking into account the burden of uncorrected refractive error, the most common cause of visual impairment (3, 30). In addition, the visual impairment and physical functioning association observed in this study could possibly be attributed to a common frailty factor associated with both conditions. While adjusted models accounted for many conditions that are associated with frailty, the possibility of an unmeasured confounder cannot be ruled out in this observational study.

Strengths of this study include its large sample size derived from a community based multiracial population, its focus on the midlife years prior to onset of major disability and debilitating ophthalmological diseases, and its use of objective measures of physical functioning. The longitudinal study design allowed us to observe the effect over several years. Ours is one of very few studies that included near vision impairment. This largely understudied parameter is paramount in adult population due to onset of presbyopia around the age of 40. Presbyopia, a condition caused by loss of elasticity of lens, affects near vision, thereby affecting everyday activity like reading, writing and computer work. By analyzing the effect of near vision impairment we were able to take into account the burden of presbyopia among this population.

In summary, this study suggests that visual impairment is a marker of poorer physical functioning up to 10 years later among midlife women. Given that 80% of visual impairment

is preventable or curable(3), regular vision testing will be of value to diagnose and treat uncorrected refractive error, and ophthalmologic conditions that are asymptomatic at early stages. Improving visual acuity among midlife individuals is an important way to address the issue of onset and progression of poor functioning and disability. Improving midlife mobility and functioning among midlife populations would in turn lead to better functioning elderly population.

Acknowledgements

We thank the study staff at each site and all the women who participated in SWAN.

Funding

The Study of Women's Health Across the Nation (SWAN) has grant support from the National Institutes of Health (NIH), DHHS, through the National Institute on Aging (NIA), the National Institute of Nursing Research (NINR) and the NIH Office of Research on Women's Health (ORWH) (Grants U01NR004061; U01AG012505, U01AG012535, U01AG012531, U01AG012539, U01AG012546, U01AG012553, U01AG012554, U01AG012495). The content of this manuscript is solely the responsibility of the authors and does not necessarily represent the official views of the NIA, NINR, ORWH or the NIH.

This study was additionally supported by 2-P30-AG-024824-11 (Karvonen-Gutierrez career development award) and University of Michigan MCubed support.

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Highlights

- The prevalence of visual impairment among mid-life women was high.
- Mid-life visual impairment predicts poorer physical functioning up to 10 years later.
- Vision correction may help prevent mid-life functional limitations.

Figure 1.

Forward Reach and Distance Visual Impairment Stratified by Obesity Status. Forward reach and distance visual impairment among women without obesity, $P = 0.016$. Forward reach and distance visual impairment among women with obesity, $P < 0.001$.

Figure 2.

Timed Walk and Near Visual Impairment Stratified by Obesity Status. Timed walk and near visual impairment among women without obesity, $P = 0.05$. Timed walk and near visual impairment among women with obesity, $P = 0.85$.

Characteristics of the Study of Women's Health Across the Nation, Michigan Site Population at Time of Baseline Vision Assessment.

Table 1

	Total (n = 483)		Visual Impairment for Distance Vision		Visual Impairment for Near Vision	
	No n = 390	Yes n = 93	No n = 292	Yes n = 191		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	P value	P value
Age, years	46.68 (2.94)	46.49 (2.96)	47.5 (2.69)	46.37 (2.94)	47.16 (2.86)	0.004
Body Mass Index, kg/m ²	32.17 (8.02)	32.47 (7.99)	30.9 (8.07)	32.09 (8.30)	32.29 (7.60)	0.80
Timed Stair Climb, seconds	19.64 (5.57)	19.66 (5.75)	19.54 (4.79)	19.18 (5.43)	20.34 (5.72)	0.03
Timed Walk, seconds	9.60 (3.15)	9.53 (3.34)	9.913 (2.17)	9.41 (3.54)	9.89 (2.43)	0.10
Forward Reach, centimeters	34.44 (7.20)	34.48 (7.20)	34.29 (7.25)	34.76 (7.42)	33.97 (6.85)	0.26
	n (%)	n (%)	n (%)	n (%)	n (%)	P value
Race/Ethnicity						
African American	289 (59.83%)	235 (60.26%)	54 (58.06%)	168 (57.52%)	121 (63.35%)	0.20
White	194 (40.17%)	155 (39.74%)	39 (41.94%)	124 (42.47%)	70 (36.65%)	
Current Smoker	123 (25.79%)	93 (24.03%)	30 (33.33%)	68 (23.61%)	55 (29.10%)	0.18
Economic Strain						
Very hard	46(13.90%)	35 (12.64%)	11 (20.37%)	24 (11.65%)	22(17.60%)	0.31
Somewhat hard	117(35.35%)	97 (35.02%)	20 (37.04%)	74 (35.92%)	43 (34.40%)	
Not at all hard	168(50.76%)	145 (52.35%)	23 (42.59%)	108 (52.43%)	60 (48%)	
Education						
Less than high school	36 (7.66%)	23 (6.08%)	13 (14.13%)	12 (4.23%)	24 (12.90%)	<0.001
High school	116 (24.68%)	95 (25.13%)	21 (22.83%)	68 (23.94%)	48 (25.81%)	
More than high school	204 (43.40%)	160 (42.33%)	44 (47.83%)	122 (42.96%)	82 (44.09%)	
College	60 (12.77%)	54 (14.29%)	6 (6.52%)	47 (16.55%)	13 (6.99%)	
Post-College	54 (11.49%)	46 (12.17%)	8 (8.70%)	35 (12.32%)	19 (10.22%)	
Using Exogenous Hormones	22 (13.41%)	14 (11.76%)	8 (17.78%)	13 (14.44%)	9 (12.16%)	0.67
Menopausal status						
Premenopausal	467 (97.09%)	379 (97.68%)	88 (94.62%)	284 (97.93%)	183 (95.81%)	0.29
Post-menopausal	14 (2.90%)	9 (2.32%)	5 (5.47%)	6 (2.06%)	8 (4.18%)	

Health Conditions

	n (%)	n (%)	P value	n (%)	n (%)	n (%)	P value	n (%)	n (%)
Hypertension	209 (43.27%)	165 (42.31%)	44 (47.31%)	0.38	116 (39.73%)	93 (48.69%)	0.05		
Diabetes mellitus	50 (10.78%)	31 (8.18%)	19 (22.35%)	<0.001	27 (9.51%)	23 (12.78%)	0.27		
Osteoarthritis	123 (25.57%)	95 (24.48%)	28 (30.11%)	0.26	73 (25.17%)	50 (26.18%)	0.81		
Stroke	8 (1.67%)	5 (1.29%)	3 (3.26%)	0.32	2 (0.69%)	6 (3.17%)	0.07		
Heart Attack	1 (0.61%)	1 (0.84%)	0 (0%)	0.31	1 (1.11%)	0 (0%)	0.32		

Association Between Visual Impairment and Performance-based Physical Functioning in the Study of Women's Health Across the Nation, Michigan Site.

Table 2

Forward Reach (centimeters)			Timed Stair Climb (seconds)			Timed Walk (seconds)		
Beta (SE)	95% CI	P value	Beta (SE)	95% CI	P value	Beta (SE)	95% CI	P value
Distant Vision Impairment								
Model 1 ^a	-1.35 (0.31)	<0.001	2.70 (0.43)	1.87, 3.54	<0.001	0.36 (0.14)	0.077, 0.64	0.013
Model 2 ^b	-2.81 (0.71)	<0.001	4.26 (0.78)	2.73, 5.79	<0.001	0.44 (0.24)	-0.03, 0.92	0.066
Model 3 ^c	-3.47 (0.70)	<0.001	4.01 (0.70)	2.63, 5.37	<0.001	0.36 (0.23)	-0.09, 0.82	0.12
Model 4 ^d	-2.90 (0.92)	0.002	2.33 (0.94)	0.49, 4.18	0.013	0.28 (0.30)	-0.31, 0.87	0.354
Near Vision Impairment								
Model 1 ^a	-1.37 (0.25)	<0.001	1.79 (0.36)	1.13, 2.45	<0.001	-0.09 (0.11)	-0.32, 0.13	0.428
Model 2 ^b	-2.26 (0.53)	<0.001	1.17 (0.60)	-0.013, 2.34	0.053	-0.07 (0.18)	-0.42, 0.29	0.704
Model 3 ^c	-1.88 (0.52)	0.0003	0.81 (0.13)	-0.23, 1.84	0.13	-0.22 (0.17)	-0.55, 0.12	0.20
Model 4 ^d	-2.43 (0.54)	<0.001	0.21 (0.58)	-0.922, 1.35	0.71	-0.264 (0.17)	-0.61, 0.08	0.129

^aUnadjusted

^bAdjusted for age, race/ethnicity, body mass index, difficulty paying for basics, smoking status, diabetes mellitus, hypertension, stroke, heart attack, menopausal status and hormone use.

^cModel 2, additionally adjusted for baseline self-reported physical functioning (SF-36 physical functioning scale).

^dModel 2, additionally adjusted for change in vision impairment from baseline vision exam to time of physical functioning assessment.