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Night Driving Self-Restriction: Vision Function and Gender Differences

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ABSTRACT: *Purpose.* The purpose of this study was to evaluate gender differences in the relationship between night driving self-restriction and vision function in an older population. *Methods.* Night driving self-restriction patterns (assessed by questionnaire) were examined cross-sectionally in relation to age, gender, health and cognitive status, depression, and vision function in a sample of 900 elders (mean age, 76 years) living in Marin County, California. *Results.* Of the total sample, 91% of men and 77% of women were current drivers. The mean age of the drivers was 73.3 years (range, 58–96 years). Among current drivers, women had slightly better vision function than men on most measures (low-contrast acuity, contrast sensitivity, low-contrast acuity in glare, low-contrast, low-luminance acuity, and glare recovery) but were twice as likely as men to restrict their driving to daytime. Men showed significant associations with avoidance of night driving on four spatial vision measures (high- and low-contrast acuity, low-contrast, low-luminance acuity, and contrast sensitivity). For women, in addition to these measures, a significant association was seen for low-contrast acuity in glare. Neither men nor women showed significant associations between driving restriction and performance on the other vision measures examined (glare recovery time, attentional field integrity, or stereopsis). The vision measures most predictive of self-restriction were contrast sensitivity for men and low-contrast acuity in glare for women. *Conclusions.* Including both cessation and self-restriction, men over age 85 years are 6.6 times more likely than women to be driving at night. For both genders, vision plays a significant role in the self-restriction decision. A higher percentage of men than women continue to drive at night with poor vision. Men's night-driving cessation was associated with contrast sensitivity and depression, whereas women's night-driving cessation was associated with low-contrast acuity in glare as well as age. (Optom Vis Sci 2005;82:755–764)

Key Words: driving, self-restriction, vision function, gender, night driving, low-contrast vision, aging

The present study was designed to investigate gender differences in driving cessation and self-restriction to daylight hours among elders in relation to their vision characteristics. Numerous authors have studied the relationships between vision and driving, and many have noted gender differences in driving cessation and self-restriction among older drivers, but so far, none has explored the influence of vision variables, if any, on these behavioral differences between the sexes.

With the rapid expansion of the elderly population, and the 85+ age group growing fastest of all,[1] people are continuing to drive well into the eighth and ninth decades of their lives.[2] Although older drivers have more crashes per mile driven, the per-driver risk of crashes is no higher than that for younger drivers.[3,4] This reflects the fact that older drivers modify their behaviors to reduce the risk by driving less[5,6] and/or adapt their driving behavior to avoid driving in certain high-risk circumstances such as at night, in the rain, in unfamiliar places, or during rush hour.[7–9] Many factors, including age, cognitive status, health status, vision, gender, trip purpose, income, education, and accessibility of services, influence the older driver's decision to give up driving or alter driving behavior.[7,10–17]

A number of authors have reported gender differences in the driving habits of elders. For example, Chipman et al.[18] found that among 897 respondents aged 80 years or over who reported their driving status in the Ontario Health Survey (a large population-based health survey), those reporting that they still drove were more likely to be male and married than those who did not. Marottoli et al.[6] interviewed 125 drivers aged 77 years and older and found that men were more likely than women to report driving in risky conditions and to acknowledge having gotten lost, having

moving violations, crashes, or near misses. Gallo et al.[8] reported results from a population-based survey of individuals over 60 years of age in which respondents who reported having stopped driving or having adapted their habits (such as not driving at night) were more likely to be female than male and more likely than current drivers to report impaired vision. Lyman et al.[12] surveyed 901 drivers aged 65 or older, finding women more likely than men to report difficulties with driving. A survey by Bauer et al.[13] of 300 drivers from 63 to 89 years old confirmed the findings of others that driving frequency is significantly associated with gender, with women much less likely than men to drive everyday. Females were less likely than males to drive at night, on long trips, or in bad weather. They were also over 75% more likely than men to report a reduction in night driving during the past year. The incidence of night-driving cessation among the Beaver Dam cohort was twice as high for women than men.[15] Hakamies-Blomqvist and Wahlstrom[19] conclude from their study that whereas men tend to keep on driving as long as their health allows them to, women give up driving for various, less pressing reasons.

Some reported results are not as clear-cut; the Bauer et al. study,[13] which compared present driving behavior with that of 5 years prior, revealed no gender differences. Dellinger et al.[20] also reported no significant gender effect in the frequency of driving cessation during the past 5 years among 1950 respondents aged 55 and older.

Many studies have demonstrated that, even given the influence of all of these social and demographic factors, associations exist between vision function and driving performance and driving habits. This is not surprising, because driving is clearly a visual task. Vision performance has been shown to be associated with crash rate[21–25] as well as driving patterns, including cessation, night-driving restriction, and avoidance of difficult driving situations.[7,11,14,17,26]

We recently described the association between demographic, general health and functioning, cognitive status, and vision variables to both vision-related and nonvision-related self-reported driving restriction in a population-based sample of older adults.[14] The present study more closely examines the association of performance on a large battery of vision tests with night-driving avoidance in this population of elders and specifically emphasizes the gender differences in these associations. Specifically, we ask whether differences in vision function between men and women exist that may contribute to the greater limitations women impose on their driving when other known factors are taken into account.

METHODS

Study Sample

The study group considered here was the SKI Study sample, described in detail in Haegerstrom-Portnoy et al.[27] This is a random, age-stratified sample of 900 community-dwelling individuals aged 58 years and older living in Marin County, north of San Francisco, California.[27,28] Individuals over age 55 were eligible for the study. Of the 900 participants in this sample, 752 were current drivers. The larger number of women than men in any random sample of this age group, combined with a higher percentage of drivers among the men, gave us an equal number of men and women drivers. The mean age of the entire sample was 75.5 years, and of the drivers, 73.3 years (range, 58–96 years). This study followed the tenets of the Declaration of Helsinki and was approved by the Smith-Kettlewell Eye Research Institute and the California Pacific Medical Center's Institute Review Board (IRB). Informed consent was obtained from each participant after an explanation of the test procedures, possible risks and discomforts.

Vision Tests

Each participant was tested using an extensive battery of vision tests that has been described in detail elsewhere.[27] Briefly, the tests included high- and low-contrast acuity (Bailey-Lovie Charts[29]); contrast sensitivity (the Pelli-Robson Chart[30]); near high-contrast and low-contrast, low-luminance acuity (SKILL Card[31]); stereopsis (Frisby Stereo Test[32]); low-contrast acuity at near with and without surrounding glare (Berkeley Glare Test[33]); glare recovery time (time to read a line on the SKILL Dark chart two lines larger than previously measured threshold on this chart following 1 min exposure to a diffuse 3300 cd/m^2 glare source); and standard and attentional visual fields (modified Synemed perimeter). To approximate real-world conditions, all vision testing was performed binocularly with habitual correction.

Other Tests

Cognitive status was assessed using the Short Portable Mental Status Questionnaire.[34] The level of depressive symptoms was assessed using the Center for Epidemiological Studies–Depression (CES-D), a 20-item scale.[35] Self-reported medical conditions were recorded by asking each subject "Have you ever been told by your doctor that you have {high blood pressure, heart attack [or other heart condition], diabetes, stroke, cancer, arthritis?}" Demographic characteristics of the sample are presented in Table 1.

Driving Habits

Driving habits were evaluated through a questionnaire (a modification of the VAQ devised by Sloane et al.[36]) that asked the subjects to rate how often a particular situation posed difficulty for them and also included items pertaining to annual mileage, driving frequency, uneasiness about driving, and highway versus nonhighway driving. Eighteen items addressed driving. Three items asked about difficulty driving at night ("I have trouble driving when there are headlights from oncoming cars in my field of view. When driving at night, objects from the side unexpectedly appear or pop up in my field of view. When driving at night in the rain, I have difficulty seeing the road because of headlights from oncoming cars."). If the subjects responded to any of these items by reporting that they do not drive at night (presented as an option to them), they were considered to restrict their driving to daylight hours.

Data Analysis

Data were analyzed using SPSS 6.1 for the Macintosh. To facilitate meaningful comparisons between different vision measures, variables were expressed in log units wherever possible (i.e., high-contrast acuity, low-contrast acuity, low-contrast, low-luminance acuity, and low-contrast acuity in glare were converted to loga-

TABLE 1.
Characteristics of study participants by driving restriction and gender category

	No driving restriction		Night-driving restriction	
	Men	Women	Men	Women
Characteristic	(N = 325)	(N = 272)	(N = 51)	(N = 104)
Mean age (SD)	73.3 (8.1)	70.7 (6.8)	78.5 (7.3)	77.6 (7.7)
Mean CES-D Score (SD)	3.9 (5.2)	5.1 (6.8)	6.3 (6.4)	6.4 (6.7)
Mean number of medical conditions (SD)	1.7 (1.4)	1.4 (1.3)	1.9 (1.3)	1.7 (1.3)
SPMSQ: percent impaired (no.)	8.3% (27)	8.8% (24)	11.8% (6)	7.7% (8)

SD, standard deviation; CES-D, Center for Epidemiological Studies–Depression; SPMSQ, Short Portable Mental Status Questionnaire.

rithm of the minimum angle of resolution [logMAR], contrast sensitivity was expressed in log units). Descriptive statistics (means, medians, standard deviation, and percentiles for continuous data and frequency distributions for categorical variables) were calculated. Differences between men and women, and driving restriction status for continuous measures were assessed with separate 2 (men vs. women) times 2 (no restriction vs. restriction) analyses of variance (ANOVAs). Categorical variables were assessed with chi-squared tests.

Separate logistic regression analyses were performed for men and women to assess the association between each vision measure and driving restriction status while taking into account potentially confounding factors (i.e., age, depressive symptoms, number of medical conditions, cognitive status). These are presented as odds ratios with 95% confidence intervals. The units for the logistic regression analyses were selected to reflect clinically meaningful differences in vision function (i.e., 0.3 log unit steps, because this reduction in acuity measures reflects a doubling of the angle of resolution or three lines on an acuity chart).

Because our previous work with this sample has revealed that the spatial vision measures are often more highly correlated with each other than the dependent variable under investigation, it is necessary to select one measure to avoid multicollinearity. Therefore, all statistically significant individual vision measures from the preliminary analyses (along with potential confounders) were included in stepwise models. Both forward and backward stepping models were run and results were confirmed using both log likelihood ratio (LR) chi-squared and Wald statistic criteria.

RESULTS

Driving Cessation

Of the 900 individuals in the sample, 148 (16.4%) reported that they are not current drivers. Of these nondrivers, 79.1% (117) had a valid driver's license in the past. Of the 31 who reported never having had a valid driver's license, 29 were women. The percentage of the 869 who had ever been drivers who reported being current drivers is listed separately for men and women across age groups in Table 2. A high percentage maintain driving into the ninth decade. Cessation of driving occurs more frequently in the oldest age groups and occurs more commonly in women, as has been previously reported.

TABLE 2.
Percent of licensed drivers still driving

Age group (years)	Male (N = 376)	Female (N = 376)	Gender difference (%)
<65	100.0	98.5	1.5
65–69	100.0	96.7	3.3
70–74	97.1	95.6	1.5
75–79	93.2	93.5	-0.2
80–84	91.8	77.5	14.3
85+	59.6	30.3	29.3

Night-Driving Avoidance

The genders happen to be equally represented among the 752 current drivers (376 men and 376 women). Table 3 lists the percentage of the current drivers who do *not* restrict their driving to daytime across age. The table shows that although female drivers are more likely than male drivers to restrict their driving to daylight at all ages, this is particularly true at the oldest ages. For example, in the oldest age group (over 85 years), 71.0% of male drivers continue to drive at night, whereas only 22% of female drivers continue to do so, a factor of 3.3 difference between men and women. The relation between age and the percentage driving without restriction is quite linear, but the slope relating percent still driving at night and age for women is approximately 2.7 times steeper than that for men. Overall, of the men who currently drive, 51 (13.6%) restrict their driving to daytime. In contrast, 104 (27.7%) women drive only during daylight hours. Thus, approximately twice as many women drivers as men restrict their driving to daytime hours.

If account is taken of driving cessation as well as driving restric-

TABLE 3.
Percent of drivers still driving at night

Age group	Male (N = 376)	Female (N = 376)	Gender difference (%)
<65	97.0	90.9	6.1
65–69	93.5	86.5	7.0
70–74	87.9	74.4	13.5
75–79	80.5	59.6	20.9
80–84	82.4	58.2	24.2
85+	71.0	21.7	49.3

tion, the observed gender difference for the oldest age group is even larger. Among those who ever drove (ex-drivers as well as current drivers), only 6.6% of women over age 85 are still driving at night, compared with 42.3% of men of the same age.

Vision Function

Small but statistically significant differences (main effect of gender in ANOVA) were found between men and women drivers on several measures of vision function: low contrast acuity (0.03 log unit difference, $p < 0.005$), contrast sensitivity (0.05 log unit difference, $p < 0.001$), low-contrast acuity in glare (0.06 log unit difference, $p < 0.005$), low-contrast, low-luminance acuity (0.07 log unit difference, $p < 0.001$), and glare recovery (0.05 log unit difference, $p < 0.05$) with women having slightly better vision than men. High-contrast acuity and attentional field integrity did not differ between genders.

Those who restrict their driving to daytime have poorer vision on all measures than those who continue to drive at night (main effect of driving restriction in ANOVA): high-contrast acuity 0.10 log unit difference, $p < 0.001$), low-contrast acuity (0.14 log unit difference, $p < 0.001$), contrast sensitivity (0.185 log unit difference, $p < 0.001$), low-contrast acuity in glare (0.23 log unit difference, $p < 0.001$), low-contrast, low-luminance acuity (0.14 log unit difference, $p < 0.001$), and glare recovery (0.20 log unit difference, $p < 0.001$; attentional field integrity 11.65% locations, $p < 0.001$).

We describe the association of vision and driving restriction among men and women separately in the following section.

Vision and Driving Restriction in Men and Women

Figure 1 shows the distributions of performance on each of the vision tests for those who drive, with separate distributions for men who do not restrict (i.e., do drive at night [MN]), women who do not restrict (WN), men who restrict driving to daylight (MR), and

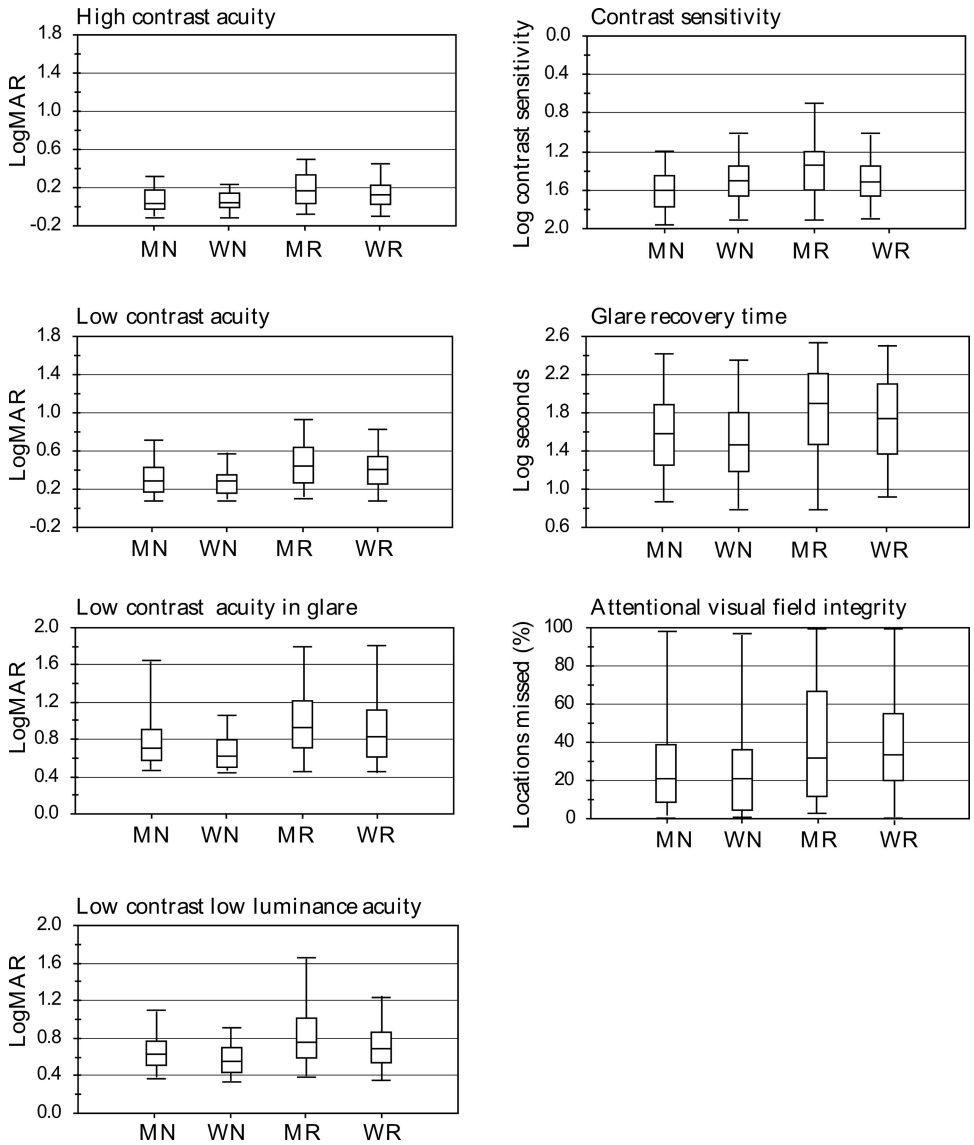

FIGURE 1.

Distribution of vision function measures presented separately for gender and driving restriction category: MN: men/nonrestrictors, WN: women/nonrestrictors, MR: men/restrictors, WR: women/restrictors. Each boxplot represents the median value (horizontal line), upper and lower quartiles (box), and the fifth and 95th percentiles (whiskers).

women who restrict their driving to daylight (WR). As one would expect among a driving population, the vast majority of individuals in all driving/gender groups had standard high-contrast acuity of 20/40 (0.30 logMAR) or better. However, among those who restrict their driving to daylight, 25.5% of men and 16.2% of women have acuity worse then 20/40 (compared with 5.8 and 1.5% among those who continue to drive at night). Similar associations for other measures are shown in Table 4. The criteria for "failing" in this table correspond to the worst vision category in a later figure (Fig. 2). Overall, far more men than women with vision function poor enough to fail these criteria continue driving at night.

Among the five measures of spatial vision, the mean difference between restricting and nonrestricting driver groups ranged from 0.09 log units (women, high-contrast acuity) to 0.26 log units (women, low-contrast acuity in glare), i.e., 1.0 to 2.6 lines of acuity under the various viewing conditions tested. The mean differences for men and women between restrictors and nonrestrictors on other measures were also fairly small: approximately 0.2 log seconds for glare recovery time and approximately 12% of locations missed for attentional field.

How poor does vision have to be before men and women modify their behavior? Figure 2 plots the percentage of men (black bars) and women (gray bars) drivers who do not restrict their driving to daytime across various levels of vision function. For each measure, the bins of vision performance differ by 0.30 log units or a factor of 2. As performance on each of the measures declines, the percentage of men and women drivers still driving at night decreases. However, there is considerable variation among the measures as to how much driving behavior varies across vision performance. For instance, as low-contrast, low-luminance acuity, low-contrast acuity in glare, or contrast sensitivity decline, the portion continuing to drive at night shows considerable falloff. In contrast, there is little change in the percentage of people driving at night across all levels of glare recovery time or attentional field integrity. Also note that for all measures, the percentage of women in the worst category of vision who continue to drive at night is smaller than the percentage of men.

The differences in behavior between men and women in the worst categories of vision are not the same for all measures. For example, for low-contrast acuity in glare or low-contrast, low-luminance acuity worse than 1.10 logMAR (20/250), more than three times as many men continue to drive at night as women, whereas, for other measures such as contrast sensitivity, glare recovery time, or attentional field integrity, the proportions of men and women not restricting their driving behavior are much more similar.

As noted earlier, overall, women drivers are twice as likely as men to restrict their driving to daytime. For this reason, one cannot glean easily from Figure 2 the relative strength of the influence of a given vision measure on the driving behavior of the two genders. This can be addressed by looking at the rates of restriction behavior across vision categories *relative* to the rate for each gender in the best category of that vision measure. Figure 3 shows this relation for four vision measures, each chosen to illustrate a different pattern of results. In each panel, the frequency of restriction for the best vision category has been set to 1, and for the other levels of vision, the factor by which the rate differs from the frequency of the best category is plotted. For contrast sensitivity, the rate of restriction does not increase over a range of approximately 0.6 log units of performance. A further decline in performance of 0.3 log units leads to a doubling of the rate of restriction for both genders. Most striking is the fact that men in the poorest category of contrast sensitivity are nearly eight times as likely to restrict their driving as men with very good contrast sensitivity; women increase their restriction by approximately a factor of 4. In contrast, women appear to be more influenced by their acuity in glare than men, increasing restriction rate by a factor of approximately 6 compared with the men's factor of 4. The association between driving behavior and low-contrast, low-luminance acuity is similar for men and women; each increase their rate of restriction by approximately a factor of 4 as their performance on this task declines. The fourth panel in Figure 3 illustrates that neither men nor women show a strong association between attentional field integrity and driving behavior; over the range of performance, the rate of restriction increases by only a factor of 2.

Logistic Regression Analyses

Logistic regression analyses were performed to more rigorously and quantitatively assess the association of each vision measure and driving restriction while taking into account potentially confounding factors (i.e., age, depressive symptoms, number of medical conditions, cognitive status). The units for the logistic regression

TABLE 4.
Percent of participants failing each vision measure by driving self-restriction and gender category

Vision measure	Fail criterion	No driving restriction		Night-driving restriction	
		Men	Women	Men	Women
High-contrast acuity	>0.30 logMAR (20/40)	5.8	1.5	25.5	16.3
Low-contrast acuity	>0.70 logMAR (20/100)	4.3	1.1	17.6	7.7
Contrast sensitivity	<1.3 log units (29 letters)	6.5	2.6	33.3	13.5
Low-contrast, low-luminance	>1.10 logMAR (20/250)	3.7	0.0	17.6	6.7
Low-contrast acuity in glare	>1.10 logMAR (20/250)	8.9	1.9	28.0	22.1
Glare recovery time	>1.8 logsec (>63 sec)	18.9	13.1	31.8	27.4
Attentional field errors	>40% of locations missed	22.6	20.2	36.7	35.1
Stereopsis	>340 arcsec (failed all plates)	11.6	6.4	20.0	18.4

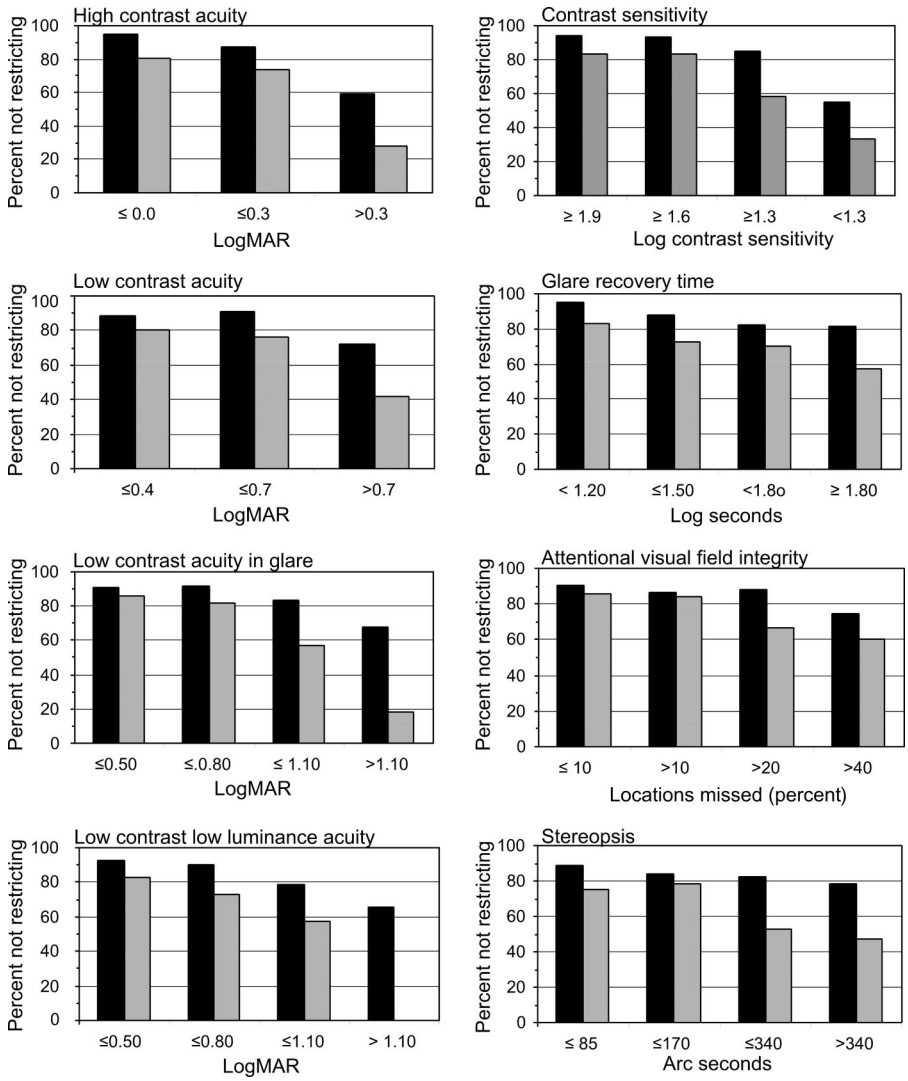

FIGURE 2.

Percent of participants within each category of vision function that still drive at night. Men: black bars, women: gray bars.

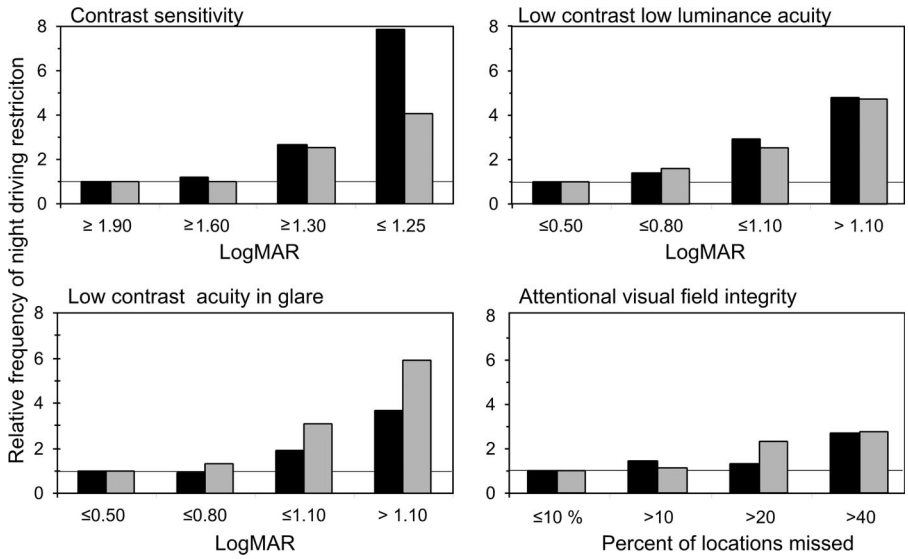

FIGURE 3.

Relative frequency of night-driving restriction for men (black bars) and women (gray bars) with various levels of vision function compared with the frequency of restriction for those in the best vision function category (set at 1; horizontal line).

analyses were selected to reflect clinically meaningful differences in vision function (i.e., 0.30 log unit steps).

In these analyses conducted separately for men and women, each individual vision measure was included in a model along with potential confounders. The resulting odds ratios (ORs) and 95% confidence intervals (CIs) are presented in Table 5. Men show significant associations between limiting their driving to daylight and several vision measures: high-contrast visual acuity; low-contrast visual acuity; low-contrast, low-luminance acuity; and, most strongly, contrast sensitivity. Women show associations for each of these measures as well as acuity in glare.

Stepwise regression models revealed that for males, contrast sensitivity had the strongest independent association with night-driving restriction (OR 2.72), whereas for women, low contrast acuity in glare had the strongest association (OR 1.84). Table 6 presents the final multivariate logistic regression analyses (which also shows the OR and CIs for confounder variables) for men (top) and women (bottom). Depressive symptoms were significantly related to men's but not women's night-driving avoidance. On the other hand, age remained a significant predictor for women, but not for men.

DISCUSSION

Our results confirm the gender disparity in driving cessation and self-restriction noted in other studies, and provide some insight into the visual factors that may influence the decision to self-restrict.

Like many previous studies,[16,18,20] we find that women are more likely than men to have never had a driver's license or to have ceased driving, particularly among the very old. We also show that if cessation of driving as well as night-driving restriction is taken into account, the gender differences become more extreme with only 6.6% of women over 85 years still driving at night compared with 42.5% of men. The overall differences between the sexes we observed in night-driving self-restriction (i.e., women drivers being approximately twice as likely as their male counterparts to limit driving to daylight hours) are also consistent with those of earlier studies. For example, Bauer et al.[13] also report a two-to-one ratio of women to men restricting their driving to daylight. The Beaver Dam study[15] showed a much higher incidence (within the past 5 years) of night-driving restriction in women drivers than in men drivers with the difference for those 80 years and over most extreme; 73.5% of women gave up night driving, whereas only 34.1% of men restricted driving in the same age group. Lyman et al.[12] report that women are twice as likely as men to have a high degree of driving difficulty in particular situations, including night driving. Hakamies-Blomqvist and Wahlstrom[19] also report that women were more likely than men to report night-driving avoidance.

The SKI Study sample comes from a community with higher levels of income and education than other large vision and aging studies. However, as Reed et al.[28] demonstrated, it has few significant differences from other large elder study samples in terms of health and functioning measures. We have also previously established[27] that it is similar in visual acuity to other vision and aging studies. The fact that its members also exhibit broadly similar behavior in driving cessation and night-driving restriction to the other studies cited here suggests that the present results have relevance to the broader societal context.

Several previous studies have examined the influence of vision on driving cessation or self-restriction. For example, the Blue Mountains Eye Study[26] reported that individuals having acuity worse than 20/40 in the better eye were four times as likely to have given up driving than individuals with better acuity. Self-reported difficulty seeing in the dark or sensitivity to glare also significantly increased the odds of driving cessation. Eleven percent of people in that study who reported having stopped driving cited vision problems as the reason. Ragland et al.[16] reported that trouble with vision was the only health problem identified as a major reason for limiting or avoiding driving. Vision was also the most often-cited reason for driving cessation among older drivers studied by Dellinger et al.[20]

Stutts[11] examined the association between the limitation of driving (to <3000 miles per year or high-risk avoidance) and gender, visual, and cognitive factors. The vision measures were high-contrast acuity, contrast sensitivity, low-contrast, low-luminance acuity, and binocular field extent, which were all included in the current study as well. Unfortunately, no vision test results are shown, precluding comparisons with the present study. Although Stutts reports significant associations (ORs) between each of the

TABLE 5.
Odds of reporting night driving self-restriction by performance on individual vision tests for men and women[a]

Vision measure	Units	Men				Women			
		OR	LCI	UCI	p	OR	LCI	UCI	p
High-contrast visual acuity	0.3 log unit	2.42	1.13	5.19	0.023	1.90	1.05	3.47	0.035
Low-contrast visual acuity	0.3 log unit	2.07	1.22	3.53	0.007	2.21	1.29	3.78	0.004
Low-contrast, low-luminance acuity	0.3 log unit	1.80	1.21	2.68	0.004	1.55	1.03	2.35	0.037
Low-contrast acuity in glare	0.3 log unit	1.33	0.99	1.80	0.062	1.84	1.33	2.54	0.000
Contrast sensitivity	0.3 log unit	2.72	1.71	4.33	0.000	1.50	1.02	2.20	0.041
Glare recovery time	0.3 log unit	1.27	0.99	1.61	0.056	1.16	0.97	1.39	0.099
Attentional field locations missed	30%	1.31	0.93	1.86	0.124	1.23	0.91	1.67	0.179
Stereopsis	0.3 log unit	1.11	0.83	1.48	0.486	1.15	0.89	1.50	0.279

[a]Adjusted for age, depressive symptoms, medical conditions, and cognitive status.
OR, odds ratio; LCI, lower confidence interval; UCI, upper confidence interval.

TABLE 6.
Final logistic regression models (odds ratios and confidence intervals for spatial vision measure and confounders) for men and women

Men					
Variable	Units	OR	LCI	UCI	p
Contrast sensitivity	0.3 log unit	2.72	1.71	4.33	0.000
Age	5 years	1.08	0.83	1.40	0.589
Depression index	5 points	1.41	1.09	1.81	0.009
Number of medical conditions	0-6	0.99	0.79	1.25	0.958
Cognitive status	categorical	0.94	0.33	2.66	0.905
Women					
Variable	Units	OR	LCI	UCI	p
Low contrast acuity in glare	0.3 log unit	1.84	1.33	2.54	0.000
Age	5 years	1.59	1.30	1.95	0.000
Depression index	5 points	1.15	0.95	1.39	0.163
Number of medical conditions	0-6	1.09	0.89	1.34	0.416
Cognitive status	categorical	1.57	0.61	4.07	0.354

OR, odds ratios and 95% confidence intervals; LCI, lower confidence interval; UCI, upper confidence interval.

vision measures and driving <3000 miles per year or high-risk avoidance, the findings are difficult to interpret. For some vision measures, ORs are reported for quartiles (of unspecified range) and arbitrary and unequal categories for other vision functions. In agreement with other studies, this study also finds that women are significantly more likely to limit their driving than men.

In our previous study,[14] we examined the association between each of the vision measures examined here and driving restriction. However, self-reported vision-related and nonvision-related restriction were considered separately and gender issues were not addressed. After adjusting for potential confounders, each of the spatial vision measures was significantly associated with vision-related restriction, as were stereopsis and glare recovery time. Only stereopsis (of the measures considered in the present study) was associated with nonvision-related restriction. In the present study, which did not consider type of restriction, but did separately consider men and women, glare recovery was not significantly associated with night-driving restriction for either group. Women showed significant associations with night-driving restriction and all spatial vision measures, but for men, low-contrast acuity in glare was not significantly associated. Stereopsis was not associated with restriction for either gender. In our previous study,[14] attentional field integrity was not associated with vision-related nor nonvision-related restriction; it was also not associated with night-driving avoidance for either gender in the present study.

Our results demonstrate that vision function is associated with the decision to stop driving at night for both genders. For men, the strongest association was seen for impaired contrast sensitivity, whereas for women, poor low-contrast acuity in glare was associated with night-driving avoidance. This is consistent with the higher prevalence of cataracts among women.[37]

In the final multivariate model, depression score (along with contrast sensitivity) was associated with night-driving restriction in men. Of course, in a cross-sectional design, causality cannot be determined. Thus, we do not know whether men stop driving at night as a result of depression or whether the cessation of night driving (for other reasons) leads to depression. Our results have shown that a much higher percentage of men with poor vision continue to drive at night. Bauer et al.[13] speculate that decisions about reductions in driving may be easier for women because men tend to have a longstanding identity with operating an automobile. Consistent with this idea, the 1990 National Personal Transportation Survey (NTPS) reported the average man drove 16,500 miles, whereas the average woman drove 9500 miles.[38] Consequently, giving up driving is a bigger change for a man.

Certainly, although vision is a contributing factor, social and cultural factors remain the most likely causes of gender differences in driving. The fact that in our society, men of all ages do more driving than women means they are giving up more if they decide not to drive or to restrict their driving. It is even possible that a decision by a wife to give up or restrict her driving may even increase the tendency and impetus for the husband to keep driving to maintain the couple's lifestyle.

Night driving might reasonably be considered a relatively high-risk behavior. The fact that men are more likely to be engaged in it (and that age is not a predictor of self-restriction) supports the established literature indicating that men in general are more likely to take risks than women.[39] Men are more likely to drive fast, have 50% more crashes than women per mile driven,[40] and account for 75% of driving fatalities.[41] In other fields such as financial affairs, it is well established that men are considerably less risk-averse than women,[42] although both exhibit increased risk aversion with age. Men are also more likely to exhibit overconfidence, especially in tasks considered to be masculine.[43] Driving certainly falls into this category.

For men, age was not a significant predictor of restriction. For women, on the other hand, age remained a significant predictor of night-driving restriction along with low-contrast acuity in glare, which is consistent with factors other than vision contributing to

the higher rate of restriction found in women with all levels of vision function.

Although most spatial vision variables are somewhat predictive of a decision to self-restrict, glare recovery and attentional visual fields are not predictive for either sex. Owsley[43] established the importance of attentional vision as measured by the Useful Field of View, so it is interesting that elders are unaware of these deficits or, if they are aware, are not using them as a basis for self-restriction.

CONCLUSIONS

Vision function contributes to the decision of older men and women to self-restrict their driving to daylight hours. Men with poor vision are more likely to continue driving at night than women with the same level of vision function, whereas women are more likely to restrict their driving at all levels of vision function. Different vision functions are predictive of self-restriction in men and women.

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