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Sleep Complaints and Visual Impairment Among Older Americans: A Community-Based Study

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Background. This report describes the associations between sleep complaints and reported visual impairment in an urban community-residing older adult sample.

Methods. A total of 1118 volunteers from a biracial cohort participated in the study (mean age = 74 ± 6; mean body mass index = 28 ± 10). Volunteers were recruited using a stratified, cluster sampling technique. In a standard order, several questionnaires were administered, soliciting information on socioeconomic status, physical health, social support, and emotional experience. The physical health questionnaire included questions on whether or not the volunteer experienced sleep disorder, visual impairment, heart disease, respiratory disease, arthritis, and hypertension. In this report, we present data on the prevalence of reported sleep problems and visual impairment among older adults.

Results. Of the total sample, 9% used sleep medicine, 25% reported difficulty falling asleep, 52% indicated experiencing difficulty maintaining sleep, 28% reported waking up early in the morning, and 12% reported daytime sleep longer than 2 hours. Chi-square results showed greater sleep complaints for volunteers with visual impairment. Consistent with these results, analysis of variance revealed that visually impaired volunteers had a higher index rate of sleep disturbance ($F_{(1, 1110)} = 35.32$, $p < .0001$).

Conclusions. These data provide evidence that older adults reporting visual impairment are also likely to report sleep complaints. This verifies laboratory findings of an association of ophthalmic diseases with sleep-wake problems and with circadian rhythm abnormalities.

ACCORDING to the 1990 census, 0.96% of adults older than the age of 40 (95 million) in the United States are legally blind (1). Of note, among adults of similar ages, visual impairment itself is slightly higher (2.24%) (1), and according to the Salisbury Eye Evaluation Study, a population-based study among noninstitutionalized Medicare enrollees aged 65–84 years, the rate increases by 3.4% (2). Research has shown that several ophthalmic diseases may contribute to the report of visual impairment (3). They include cataract, glaucoma, macular degeneration, diabetic retinopathy, and optic nerve atrophy (4,5). These diseases are associated with diminished capacity as measured by activity of daily living scales, reduced quality of life, impaired sleep quality, and depressed moods (6–9). Furthermore, they could also have a negative effect on the suprachiasmatic nucleus (SCN) of the hypothalamus, the endogenous circadian pacemaker, by decreasing photic input. This finding is particularly important because in humans and other mammals, the SCN, the biological clock of the brain, controls most circadian rhythms, such as rest-activity rhythm (10), body temperature, corticosterone secretion, heart rate, and pineal N-acetyltransferase (11–15), which indirectly regulates physiologic and behavioral functions (16–18).

Research conducted with adults without visual compromise has shown that the photosensory system provides photic input to the SCN. This in turn synchronizes several biological rhythms (e.g., sleep-wake cycles) to a 24-hour day (19). However, in persons with complete absence of light perception, the SCN free-runs (20), and these rhythms remain in a large measure desynchronized (21,22). It has been established that the consequences of a desynchronized SCN among blind individuals include sleep disturbances and depressed moods (21,22). However, for those who are visually impaired, the consequences of a malsynchronized SCN remain unclear, although it is speculated that those patients might experience dampened endogenous rhythms, often resulting in sleep disturbances and depression (21,23).

Recent data from a survey conducted by the National Sleep Foundation have suggested that 39% of respondents aged 65 years and older experienced symptoms of insomnia (24). Moreover, as found in clinical studies, sleep disturbances among older adults may have several etiologies. Indeed, there is a body of research demonstrating relations of sleep disturbances to several medical and psychiatric conditions (25–31).

The notion of a possible association between sleep and ophthalmic abnormalities has been investigated. For example, sleep apnea, one of the most common sleep disorders, has been reported to be associated with glaucoma (32), floppy eyelid syndrome (33,34), keratoconus (35), papilledema (36), and optic neuropathy (37). It is also assumed that optic nerve vascular dysregulation might be secondary

to sleep-disordered breathing-induced arterial hypertension and arteriosclerosis, and/or the imbalance between nitric oxide (a vasodilator) and endothelin (a vasoconstrictor) (38). Others have suggested that repetitive prolonged hypoxia, a phenomenon that is common during apneic episodes, might also directly damage the optic nerve (32). However, little is known about the relationship between sleep complaints and self-reported visual impairment. In this study, we examined the associations between sleep complaints and visual impairment among urban community-residing older Americans.

Methods

Participants and Procedures

A total of 1118 volunteers from a biracial cohort (60% African Americans, 40% European Americans) in Brooklyn, New York, participated in the study (Table 1). Volunteers were recruited using a stratified, cluster sampling technique, and those who provided valid data were paid $20 for their participation. Trained interviewers of the same race as the respondents gathered data during face-to-face interviews conducted either in the respondent's home or another location of their choice; interviews lasted approximately an hour and a half. In a standard order, several questionnaires were administered soliciting information on socioeconomic status, physical health, social support, and emotional experience.

This report is based on sociodemographic and physical health data, as part of a larger study on stress and coping among adult Americans. The sociodemographic data included age, gender, ethnicity, household income, and educational attainment. Physical health was measured with the Comprehensive Assessment and Referral Evaluation Scale (39). This instrument is used to assess physical disability and has been used extensively in investigations involving older individuals in minority populations and has shown good construct validity (40) as well as concurrent and predictive validity (41). The physical health questionnaire included questions on sleep disorders, visual impairment, heart disease, respiratory disease, arthritis, and hypertension.

Statistical Analysis

The present analysis focuses on the sleep disorder and the visual impairment components of the physical health questionnaire. Six questions comprise the sleep disorder subscale (Table 2). Eleven questions comprise the visual impairment subscale (Table 3).

To explore the relationship between sleep complaint and visual impairment, chi-square tests were used with two dummy-coded variables: sleep complaint (yes or no) and visual impairment (yes or no). Individuals responding yes to any of the five questions composing the sleep disorder subscale were coded as one, and those responding no to all five were coded as zero. Individuals responding yes to any of the 11 questions from the visual impairment subscale were coded as one, and those responding no to all 11 were coded as zero. It was hypothesized that individuals reporting visual impairment would also report sleep complaints. Using analysis of variance (ANOVA), volunteers with and without visual impairment were further compared using a severity index for sleep difficulty based on the cumulative summary of the five sleep questions. This analysis was performed to determine whether the pattern of sleep complaints was consistent across the sample.

Table 1. Sociodemographic Characteristics of Participating Older Adults

Variable	African American	European American
Mean Age (*SD*)	74 (6)	75 (6)
Mean Household Income, $10,000 (*SD*)	17 (16)	21 (12)
Female, %	62	63
Married, %	30	44
No High School Degree, %	64	36

Table 2. Sleep Questionnaire

Question	% Yes
1. Do you depend on medications to sleep?	8.7
2. Do you have difficulty falling asleep?	24.8
3. Do you wake up often during the night?	52.1
4. Do you wake up too early?	28.4
5. Do you wake up feeling tired?	28.2
6. Do you sleep during the day for more than 2 hours?	12.0

Results

Of the total sample, 45% reported visual impairment, 9% indicated a reliance on medicine to sleep, 25% reported difficulty falling asleep, 52% reported difficulty maintaining sleep, 28% reported early morning awakening, and 12% reported daytime sleep longer than 2 hours. Responses to sleep questions on the basis of whether individuals reported visual impairment are compared in Table 4, showing more sleep complaints for elders with visual impairment. Consistent with the chi-square results, ANOVA showed that visually impaired participants had a higher index rate of sleep disturbances than their counterparts ($F(1,1110) = 35.32$, $p < .0001$).

Discussion

To our knowledge, this is the first study that investigated the relationships between sleep complaints and visual impairment in a community-based sample of older Americans. Our analyses suggested an association between self-reported visual impairment and sleep complaints. These re-

Table 3. Vision Questionnaire

Question	% Yes
1. Do you have poor vision even with glasses, such that it limits desired activities?	20.4
2. Do you find you can't read regular print?	16.7
3. Do you find you can't read a telephone directory?	18.4
4. Do you find you can't read or see public signs or traffic?	9.5
5. Do you find that leisure activities are curtailed by your vision?	10.9
6. Do you find reading labels or prices is a problem?	17.5
7. Do you have difficulty recognizing people due to poor eyesight?	16.5
8. Do you have difficulty reading labels on medicine bottles?	16.5
9. Do you have difficulty seeing steps due to poor eyesight?	9.0
10. Do you have difficulty seeing in poor or dim light?	28.1
11. Is housework restricted by poor eyesight?	7.0

Table 4. Proportion of Sleep-Related Problems by Visual Impairment

Variable	Yes	No	χ^2
Difficulty Falling Asleep (%)	35	17	48**
Difficulty Maintaining Sleep (%)	61	45	30**
Early Morning Awakening (%)	39	20	45**
Daytime Sleep (%)	14	10	5*
Sleep Medicine (%)	13	5	23**

*$p < .05$; **$p < .01$.

sults are important in the sense that they verify laboratory findings, which showed an association of ophthalmic diseases with sleep-wake problems (18,22) and with circadian rhythm abnormalities (21). Some investigators have found that up to 55% of patients without light perception experience desynchronized circadian rhythms with accompanying sleep disturbances (21). Thus, blind patients exhibit a much higher frequency of nocturnal sleep disruptions and insomnia than age-matched visually intact individuals.

Compared with a previous study (42), which found that 26.9% of Swedish respondents with a mean age of 73 years reported visual impairment, a greater proportion of elders (45%) in our study were visually impaired. This may be explained by the fact that our survey included several questions ascertaining problems with vision, whereas the previous study used only one question: "I have good eyesight" (y/n). It is important to note, nonetheless, that both studies may have overestimated the actual rate of visual impairment in the population.

We acknowledge that causal inferences cannot be drawn from our results, but some suggestions can be gleaned from the study. The association between sleep complaints and visual impairment suggests that respondents may be experiencing sleep disturbances because of an inability to regulate light stimuli; light is believed to be the best synchronizer of sleep-wake cycles (43–45). It is also likely that visual impairment, which limits outdoor activities, does not offer an opportunity for bright light exposure. It has been found that even healthy older adults spend only 1 hour daily in outdoor daylight receiving up to 2000 lux (46), and at home, daily illumination levels are usually below 300 lux, the commonly quoted office lighting intensity (47). One could also surmise that reduction of daytime activity itself might contribute to the disregulation of sleep-wake patterns, leaving even more uncertain the direct effect of visual impairment on sleep.

To determine further the factors that might help explain the present findings, we conducted several analyses to ascertain whether these findings may have been influenced by a response bias. Thus, a random sample of the health questions was used to determine the degree to which they correlated with sleep complaints. In addition to visual impairment, only hypertension correlated moderately with sleep complaints. Such results are not surprising, because hypertension has been demonstrated to be associated with sleep-disordered breathing (48–50). Another way to test for possible response bias would be to assess whether auditory disturbance to some degree may have been responsible for sleep complaints. Our analysis did not show any significant correlation between hearing complaints and sleep complaints. Ultimately, the ideal way to verify these findings is to have objective ophthalmic and sleep assessment for those participants, which remains an important empirical question for future studies (51).

These data suggest that visual impairment may have an effect on sleep among elderly adults, either by limiting daily activity or by reducing light exposure. However, causal links will have to be established by systematic, controlled studies. The observations of this study warrant further investigations on the relationship between visual impairment and sleep disturbance with objective measures, as respondents may have overestimated vision problems. It is suggested that elderly volunteers undergo baseline ophthalmic assessment before assignment to treatment conditions in bright light studies. This suggestion is supported by findings that visually impaired elders with dementia did not respond to light treatment, whereas visually intact patients responded positively (52). It is also conceivable that older adults with visual impairment might necessitate brighter illumination for circadian entrainment. Indeed, work by Lucassen and colleagues (53) suggested that aged-related declines in some components of SCN functions may be countered by high-intensity light exposure.

Some methodological issues might limit the generalizability of the present findings. One possible limitation of the study is that we used a sampling technique that favored the recruitment of a high percentage of African Americans relative to European Americans, although we did not specifically ask questions about specific eye conditions. It is known that glaucoma, cataract, and diabetic retinopathy are more prevalent among African Americans, whereas macular degeneration is more prevalent among European Americans (2).

With respect to sleep complaints, there have been conflicting observations made regarding ethnic differences. Some studies have shown greater sleep problems among African Americans, whereas others have indicated fewer sleep complaints (29,54). To assess further the effect of ethnicity on sleep complaints, we conducted a separate analysis on the data (published elsewhere), which assessed the unique contribution of several demographic, lifestyle, stress, and health-related factors in explaining the variance in reported sleep problems. In addition, consistent with evidence showing ethnic disparity in health status, we examined ethnic differences for each sleep-related complaint. African Americans in our data reported fewer sleep complaints than their European-immigrant counterparts (51).

Another relates to the fact that the ethnic composition of our Brooklyn sample may not reflect the U.S. population as a whole. However, trends observed in our study were consistent with findings from the Swedish sample, suggesting that these self-reported data may be observed across other U.S. cities.

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References

1. *1990 US Census Data. Database: C90STF1C. Summary Level: Nation; 1990*. Retrieved October 5, 2001, from http://www.census.gov/hhes/www/disable/census.html
2. Munoz B, West SK, Rubin GS, et al. Causes of blindness and visual impairment in a population of older Americans: the Salisbury Eye Evaluation Study. *Arch Ophthalmol*. 2000;118:819–825.
3. VanNewkirk MR, Weih L, McCarty CA, Taylor HR. Cause-specific prevalence of bilateral visual impairment in Victoria, Australia: the Visual Impairment Project. *Ophthalmology*. 2001;108:960–967.
4. Kini MM, Leibowitz HM, Colton T, Nickerson RJ, Ganley J, Dawber TR. Prevalence of senile cataract, diabetic retinopathy, senile macular degeneration, and open-angle glaucoma in the Framingham Eye Study. *Am J Ophthalmol*. 1978;85:28–34.
5. Pizzarello LD. The dimensions of the problem of eye disease among the elderly. *Ophthalmology*. 1987;94:1191–1195.
6. Tabandeh H, Lockley SW, Buttery R, et al. Disturbance of sleep in blindness. *Am J Ophthalmol*. 1998;126:707–712.
7. Rosenthal NE, DellaBella P, Hahn L, Skwerer RG. Seasonal affective disorder and visual impairment: two case studies. *J Clin Psychiatry*. 1989;50(12):469–472.
8. Coleman AL. Glaucoma. *Lancet*. 1999;354:1803–1810.
9. Scott IU, Smiddy WE, Schiffman J, Feuer WJ, Pappas CJ. Quality of life of low-vision patients and the impact of low-vision services. *Am J Ophthalmol*. 1999;128:54–62.
10. Ibuka N, Kawamura H. Loss of circadian rhythm in sleep-wakefulness cycle in the rat by suprachiasmatic nucleus lesions. *Brain Res*. 1975; 96:76–81.
11. Rusak B. Neural mechanisms for entrainment and generation of mammalian circadian rhythms. *Fed Proc*. 1979;38:2589–2595.
12. Scheer FA, van Doornen LJ, Buijs RM. Light and diurnal cycle affect human heart rate: possible role for the circadian pacemaker. *J Biol Rhythms*. 1999;14(3):202–212.
13. Warren WS, Champney TH, Cassone VM. The suprachiasmatic nucleus controls the circadian rhythm of heart rate via the sympathetic nervous system. *Physiol Behav*. 1994;55:1091–1099.
14. Buijs RM, Kalsbeek A, van der Woude TP, van Heerikhuize JJ, Shinn S. Suprachiasmatic nucleus lesion increases corticosterone secretion. *Am J Physiol*. 1994;264:R1186–R1192.
15. Gillette MU, Tischkau SA. Suprachiasmatic nucleus: the brain's circadian clock. *Recent Prog Horm Res*. 1999;54:33–58, discussion 58–59.
16. Moore-Ede MC, Czeisler CA, Richardson GS. Circadian timekeeping in health and disease. Part 1. Basic properties of circadian pacemakers. *N Engl J Med*. 1983;309:530–536.
17. Moore-Ede MC, Czeisler CA, Richardson GS. Circadian timekeeping in health and disease. Part 2. Clinical implications of circadian rhythmicity. *Ciba Found Symp*. 1985;117:23–37.
18. Thompson C. Circadian rhythms. *Br J Psychiatry*. 1985;146:557–558.
19. Moore RY, Lenn NJ. A retinohypothalamic projection in the rat. *J Comp Neurol*. 1972;146:1–14.
20. Czeisler CA, Shanahan TL, Klerman EB, et al. Suppression of melatonin secretion in some blind patients by exposure to bright light [see comments]. *N Engl J Med*. 1995;332:6–11.
21. Sack RL, Lewy AJ, Blood ML, Keith LD, Nakagawa H. Circadian rhythm abnormalities in totally blind people: incidence and clinical significance. *J Clin Endocrinol Metab*. 1992;75:127–134.
22. Leger D, Guilleminault C, Defrance R, Domont A, Paillard M. Prevalence of sleep/wake disorders in persons with blindness. *Clin Sci (Colch)*. 1999;97:193–199.
23. Miles LE, Raynal DM, Wilson MA. Blind man living in normal society has circadian rhythms of 24.9 hours. *Science*. 1977;198:421–423.
24. *2001 Omnibus Sleep in America Poll.* Retrieved October 4, 2001, from http://www.sleepfoundation.org/publications/2001poll.html
25. Bliwise DL, King AC, Harris RB. Habitual sleep durations and health in a 50–65 year old population. *J Clin Epidemiol*. 1994;47:35–41.
26. Habte-Gabr E, Wallace RB, Colsher PL, Hulbert JR, White LR, Smith IM. Sleep patterns in rural elders: demographic, health, and psychobehavioral correlates. *J Clin Epidemiol*. 1991;44:5–13.
27. Briones B, Adams N, Strauss M, et al. Relationship between sleepiness and general health status. *Sleep*. 1996;19:583–588.
28. Bliwise DL, Friedman L, Yesavage JA. Depression as a confounding variable in the estimation of habitual sleep time. *Psychiatry Res*. 1993; 48:277–292.
29. Blazer DG, Hays JC, Foley DJ. Sleep complaints in older adults: a racial comparison. *J Gerontol Med Sci*. 1995;50A:M280–M284.
30. Maggi S, Langlois JA, Minicuci N, et al. Sleep complaints in community-dwelling older persons: prevalence, associated factors, and reported causes. *J Am Geriatr Soc*. 1998;46:161–168.
31. Foley DJ, Monjan AA, Wallace RB, Blazer D. Incidence and remission of insomnia among elderly adults: an epidemiologic study of 6,800 persons over three years. *Sleep*. 1999;22:S366–S372.
32. Mojon DS, Hess CW, Goldblum D, et al. High prevalence of glaucoma in patients with sleep apnea syndrome. *Ophthalmology*. 1999; 106:1009–1012.
33. Robert PY, Adenis JP, Tapie P, Melloni B. Eyelid hyperlaxity and obstructive sleep apnea (O.S.A.) syndrome. *Eur J Ophthalmol*. 1997; 7(3):211–215.
34. McNab AA. Floppy eyelid syndrome and obstructive sleep apnea. *Ophthal Plast Reconstr Surg*. 1997;13(2):98–114.
35. Culbertson WW, Tseng SC. Corneal disorders in floppy eyelid syndrome. *Cornea*. 1994;13(1):33–42.
36. Bucci FA Jr, Krohel GB. Optic nerve swelling secondary to the obstructive sleep apnea syndrome. *Am J Ophthalmol*. 1988;105:428–430.
37. Mojon DS, Mathis J, Zulauf M, Koerner F, Hess CW. Optic neuropathy associated with sleep apnea syndrome. *Ophthalmology*. 1998; 105:874–877.
38. Luscher TF. Endothelium in the control of vascular tone and growth: role of local mediators and mechanical forces. *Blood Press*. 1994;1: 18–22.
39. Gurland B, Golden RR, Teresi JA, Challop J. The SHORT-CARE: an efficient instrument for the assessment of depression, dementia and disability. *J Gerontol*. 1984;39:166–169.
40. Teresi JA, Golden RR, Gurland BJ, Wilder DE, Bennett RG. Construct validity of indicator-scales developed from the Comprehensive Assessment and Referral Evaluation interview schedule. *J Gerontol*. 1984;39:147–157.
41. Teresi JA, Golden RR, Gurland BJ. Concurrent and predictive validity of indicator scales developed for the Comprehensive Assessment and Referral Evaluation interview schedule. *J Gerontol*. 1984;39:158–165.
42. Asplund R. Sleep, health, and visual impairment in the elderly. *Arch Gen Geriatrics*. 2000;30:7–15.
43. Czeisler CA, Richardson GS, Zimmerman JC, Moore-Ede MC, Weitzman ED. Entrainment of human circadian rhythms by light-dark cycles: a reassessment. *Photochem Photobiol*. 1980;34:239–247.
44. Czeisler CA, Allan JS, Strogatz SH, et al. Bright light resets the human circadian pacemaker independent of the timing of the sleep-wake cycle. *Science*. 1986;8:667–671.
45. Campbell SS, Eastman CI, Terman M, Lewy AJ, Boulos Z, Dijk DJ. Light treatment for sleep disorders: consensus report. I. Chronology of seminal studies in humans. *J Biol Rhythms*. 1995;10:105–109.
46. Kripke DF. Light treatment for nonseasonal depression: speed, efficacy, and combined treatment. *J Affect Disord*. 1998;49:109–117.
47. Kripke DF, Juarez S, Cole RJ, et al. Adult illumination exposures and some correlations with symptoms. In: Hiroshige T, Honma K, eds. *Evolution of Circadian Clock*. Sapporo, Japan: Hokkaido University Press; 1994:349–360.
48. Guilleminault C, Robinson A. Sleep-disordered breathing and hypertension: past lessons, future directions. *Sleep*. 1920;20:806–811.
49. Ohayon MM, Guilleminault C, Priest RG, Zulley J, Smirne S. Is sleep-disordered breathing an independent risk factor for hypertension in the general population (13,057 subjects)? *J Psychosom Res*. 1948;48:593–601.
50. Fletcher EC. The relationship between systemic hypertension and obstructive sleep apnea: facts and theory. *Am J Med*. 1998;98(2):118–128.
51. Jean-Louis G, Magai C, Cohen CI, et al. Ethnic differences in reported sleep problems in older adults. *Sleep*. 2001;24:926–933.
52. Van Someren EJ. Circadian rhythms and sleep in human aging. *Chronobiol Int*. 2000;17:233–243.
53. Lucassen PJ, Hofman MA, Swaab DF. Increased light intensity prevents the age related loss of vasopressin-expressing neurons in the rat suprachiasmatic nucleus. *Brain Res*. 1995;693:261–266.
54. Hicks RA, Lucero-Gorman K, Bautista J, Hicks GJ. Ethnicity, sleep duration, and sleep satisfaction. *Percept Mot Skills*. 1999;88(1):234–235.

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