Published in final edited form as:

Invest Ophthalmol Vis Sci. 2009 April ; 50(4): 1585–1592. doi:10.1167/iovs.08-2744.

Family Caregiver Social Problem-Solving Abilities and Adjustment to Caring for a Relative with Vision Loss

Jennifer K. Bambara¹, Cynthia Owsley², Virginia Wadley³, Roy Martin⁴, Chebon Porter⁵, and Laura E. Dreer²

¹Department of Psychology, University of Alabama at Birmingham, Birmingham, Alabama

²Department of Ophthalmology, University of Alabama at Birmingham, Birmingham, Alabama

³Department of Gerontology/Geriatrics/Palliative Care, University of Alabama at Birmingham, Birmingham, Alabama

⁴Department of Neurology, University of Alabama at Birmingham, Birmingham, Alabama

⁵Veterans Affairs Medical Center (VAMC), Birmingham, Alabama

Abstract

Purpose—To examine the prevalence of persons at risk for depression among family caregivers of visually impaired persons and the extent to which social problem-solving abilities are associated with caregiver depressive symptomatology and life satisfaction.

Methods—Family caregivers were defined as adults who accompanied their adult relative to an appointment at a low-vision rehabilitation clinic and self-identified themselves as the primary family caregiver responsible for providing some form of assistance for their relative due to vision impairment. Demographic variables, depressive symptoms, life satisfaction, caregiver burden, and social problem-solving abilities were assessed in caregivers. The patient's visual acuity and depressive symptoms and their relationship to the caregiver's depressive symptoms and life satisfaction were also examined.

Results—Ninety-six family caregivers were enrolled. Of those, 35.4% were identified as at risk for depression. Among caregivers, dysfunctional or ineffective social problem-solving abilities were significantly associated with greater depressive symptomatology and decreased life satisfaction after adjustment for caregiver burden and demographic and medical variables for both the caregiver and the visually impaired patient. Problem orientation or motivation to solving problems was also significantly associated with caregiver depression and satisfaction with life.

Conclusions—A substantial number of caregivers of visually impaired adults experience psychosocial distress, particularly among those who possess poor social problem-solving abilities. These results underscore the need for routine screening and treatment of emotional distress among individuals caring for relatives with vision impairments. Future research should examine the extent to which psychosocial interventions targeting caregiver social problem-solving skills may be useful not only in improving caregiver quality of life but also in subsequently enhancing rehabilitation outcomes for the visually impaired care recipient.

Vision impairment is one of the leading causes of disability in the United States and has been estimated to affect approximately 14 million individuals.^{1,2} Because vision loss often interferes with one's ability to engage in instrumental activities of everyday living (e.g., driving, financial management, and medication management),³⁻¹⁰ family members are often called on to provide physical and emotional support.¹¹⁻¹⁴ The level of support provided may increase substantially when a person with a vision impairment has a comorbid chronic health condition requiring greater assistance.¹⁵ Family members who serve as informal caregivers may be susceptible to problems with their own adjustment related to their caregiver role and responsibilities. However, little is known about the adjustment process of family members who care for visually impaired adults. This lack of understanding is unfortunate considering the accumulating evidence documenting the influence of family caregiver functioning and support on patient rehabilitation and health outcomes.^{16,17}

Family caregivers often provide assistance without formal training or preparation but are increasingly expected to function competently as informal extensions of healthcare systems.¹⁸⁻²¹ Caregiver responsibilities with respect to caring for adults with vision impairments include assisting relatives with activities in everyday living (e.g., reading, transportation, financial management, and personal care), promoting compliance with medical-behavioral regimens (e.g., routine application of eye drops, checking blood glucose levels, and medication management), and executing therapeutic rehabilitation directives in the home (e.g., using residual vision more effectively and low vision aides/devices). Family caregivers often provide emotional support as well. Despite their valuable function, family members who serve in this important role are rarely compensated for their services or their time and are at risk of neglecting their own needs, leisure pursuits, and personal/family interests.^{18,21,22} Thus, caregivers typically receive little positive reinforcement for their efforts.

Considerable evidence indicates that expending significant financial, emotional, and physical resources while receiving little in return may result in what is referred to as caregiver burden. This burden may result in role overload, strain, and stress, which may compromise the caregiver's quality of life and contribute to depression.^{18,23-26} Female caregivers in particular have been found to be at greater risk of feeling burdened and experiencing negative outcomes.²⁷⁻²⁹ In addition to the personal costs of caregiver burden, such strain may negatively impact rehabilitation and health outcomes for the care recipient.

Although caregivers are at risk of burnout and adjustment difficulties, providing care for a relative is not a uniform experience.³⁰ For example, family caregivers have been found to vary in the way in which they adjust to the role of caregiver and how they solve problems associated with caregiving.^{18,21,31} Accumulating research implicates social problem-solving abilities as important determinants of adjustment to caregiving (Dreer L, et al. *IOVS* 2004;45:ARVO E-Abstract 1380).^{21,32,33} Effective problem-solving abilities are associated with caregiver well-being, and caregivers who possess ineffective social problem-solving abilities are more likely to experience depressive symptomatology, anxiety, and poor health.²¹ Furthermore, several studies support the value of interventions based on a problem-solving theory framework for decreasing emotional distress and improving self-management skills.^{34,35}

Little is known about the family caregiver experience or the cognitive-behavioral characteristics such as social problem-solving abilities that influence the adjustment process for those who care for persons with vision loss. Although there has been a wealth of research documenting the supportive role of family members of persons with vision impairments (i.e., instrumental and emotional support) and the positive influence of family members and friends on rehabilitation outcomes of persons with vision loss,^{12,36-39} the degree of distress, rates of depression, and factors that protect against the stress experienced by these caregivers remain understudied. This information would be valuable given the influence family members have

on rehabilitation and health outcomes of persons with vision loss. Knowledge about the factors that affect caregiver adjustment may promote the development of preventive efforts and psychosocial interventions targeted toward the specific needs of those caring for a relative with vision loss.

Thus, the present study was designed to determine the prevalence of persons at risk for depression among family caregivers of persons with vision loss and to examine the associations between social problem-solving abilities and depressive symptoms and life satisfaction in these persons. According to the basic tenets of the social problem-solving model, a negative problem orientation should be predictive of negative caregiver emotional experience. It was hypothesized that a negative problem orientation would be significantly predictive of higher caregiver self-reported depressive symptoms and lower general well-being, regardless of caregiver age and sex, the severity of the patient's visual acuity, or the level of the patient's emotional functioning.

Methods

Participants

The sample consisted of patients (age 19 years or older) with adult-onset vision loss who presented for an initial eye examination at a low-vision rehabilitation clinic and the family members who accompanied them. Inclusion criteria for family caregivers were: age 19 years or older and self-identification as the primary family caregiver responsible for providing some form of assistance to a relative due to vision impairment. Individuals were excluded if they received financial compensation for their services, did not provide assistance to a relative, or did not speak fluent English. Interested family caregiver and patient participants who met eligibility criteria gave written informed consent to participate in the investigation, in accordance Declaration of Helsinki. Patients and family caregivers completed all self-report questionnaires separately after the patient's initial low-vision rehabilitation evaluation. The protocol for this study was approved by the Institutional Review Board of the University of Alabama at Birmingham for the protection of human subjects.

Measures

Caregiver Data

Demographic Information: Family caregiver demographic data included age, sex, race, education, marital status, employment status, and relationship to patient.

Social Problem-Solving Abilities: The Social Problem-Solving Inventory-Revised short form (SPSI-R)⁴⁰ is a 25-item self-report measure designed to assess social problem-solving abilities. The SPSI-R assesses two adaptive problem-solving dimensions (positive problem orientation and rational problem-solving) and three dysfunctional dimensions (negative problem orientation, impulsive/careless style, and avoidance style). The five major components, along with sample questions that comprise each scale, are as follows: *positive problem orientation* (PPO), "When I have a problem, I try to see it as a challenge or opportunity to benefit in some positive way from having the problem"; *negative problem orientation* (NPO), "When I am faced with a difficult problem, I doubt that I will be able to solve it on my own no matter how hard I try"; *impulsive/careless style* (ICS), "When I am trying to solve a problem, I go with the first good idea that comes to mind"; *avoidance style* (AS), "When a problem occurs in my life, I put off trying to solve it for as long as possible"; and *rational problem solving* (RPS), "When I have a decision to make, I try to predict the positive and negative consequences of each option." Items on the SPSI-R are rated on a five-point Likert-type scale (0, not at all true of me, to 4, extremely true of me). Higher scores on each factor indicate greater intensity on that particular dimension. The SPSI-R has shown high reliability (α coefficients for the subscales

ranging from 0.72-0.85) and has been found to be moderately and significantly correlated with other external measures of psychological distress and well-being.^{40,41}

Depressive Symptoms: The Center for Epidemiologic Studies-Depression Scale (CES-D)⁴² was used to obtain an index of depressive symptoms. This 20-item, self-report measure assesses current levels of depressive symptomatology. Items are scored on a 4-point scale to indicate symptom frequency during the preceding week, with scores ranging from 0 to 60. Higher scores indicate greater depressive symptomatology. Several studies have supported the discriminant and convergent validity of the scale,⁴²⁻⁴⁵ and acceptable internal reliability coefficients have been reported (range, 0.84 - 0.90).^{42,46-48} Using the standard criterion for the CES-D, we categorized participants as nondepressed (CES-D score < 16) or at risk of depression (CES-D score $\geq$ 16).⁴⁹

Life Satisfaction: The Satisfaction with Life Scale (SWLS)⁵⁰ was used to evaluate subjective well-being and overall life satisfaction of family caregivers. It is a five-item self-report instrument with items rated on a Likert type response format ranging from 1 (strongly disagree) to 7 (strongly agree). Higher scores reflect greater subjective well-being. Psychometric studies of the SWLS have evidenced internal consistency ($\alpha = 0.87$) and reliability (2-month test-retest coefficient = 0.82).⁵⁰

Caregiver Burden: Perception of caregiver burden was measured using the difficulty subscale of the Caregiver Burden Scale (CBS).⁵¹ The difficulty subscale measures the difficulty associated with 14 direct, instrumental, and interpersonal demands common for family caregivers. This scale was used because it is a better predictor of caregiving burden than demand alone or the total score.⁵¹ Difficulty of activities are rated on a 5-point Likert scale ranging from 1 (none) to 5 (a great amount/extremely difficult), with higher scores reflecting greater perceived burden. The subscale possesses high reliability (0.91) and good internal consistency (Cronbach α range, 0.87-0.91).^{35,51}

Patient Data

Demographic Information and Medical History: Demographic data (i.e., age, race, and sex) and self-reported medical history were collected from the patient's medical record after the initial low vision evaluation.

Vision Loss: Distance acuity of the patient was assessed using the standard protocol for the ETDRS chart^{52,53} and was expressed as logMAR. For the purposes of this study, logMAR scores in the better eye were used to indicate degree of visual impairment with higher logMAR scores reflecting greater visual impairment. Self-reported onset of vision loss (i.e., sudden or gradual) was determined by the eye care provider.

Depressive Symptoms: The CES-D, as described above, was also administered to patients to assess depressive symptoms during the past week.

Statistical Analysis

Using the criterion of a CES-D score $\geq$ 16, we determined the percentage of caregivers at risk for depression. Initial analyses compared continuous and categorical data using independent-samples *t*-test and χ^2 , respectively to assess differences between caregiver demographic variables and caregiver self-report measures by depression status. Correlational analyses examined associations between caregiver demographic variables, depressive symptomatology, burden, satisfaction with life, and social problem-solving abilities, along with patient demographic/medical variables. After the procedures used in prior tests of the social problem-solving model,^{20,22} separate hierarchical regression equations were computed to predict

caregiver depressive symptoms and caregiver satisfaction with life. We examined the extent to which caregiver problem-solving abilities were associated with caregiver distress above and beyond the variance attributable to patient and caregiver demographic variables, patient visual acuity, patient distress, and caregiver burden. Statistical significance was set at $P < 0.05$ (two-tailed; SPSS software ver. 15; SPSS Sciences, Chicago, IL).

Results

Of the 133 patients screened, 14 had no identified caregiver and 6 were accompanied by non-family member(s) (i.e., friend, driver, or paid caregiver). Of the remaining 113 eligible family caregivers, 17 declined to participate. The final sample consisted of 96 patient-caregiver dyads. Demographic characteristics of the caregiver and patient sample are provided in Table 1. Focusing first on the caregivers, the average age was 59 years ($SD = 13.81$), and the majority (70.8%) of caregivers were women. Caregiver participants were most often Caucasian (90.6%), with the balance African American (8.3%) and one Asian. Most of the caregivers were either spouses (37.5%) or adult daughters (33.3%). The majority (72.9%) of caregivers were married. Approximately half (47.9%) of the caregivers were employed, a quarter (25%) were unemployed, and just less than a quarter (20.8%) were retired. The average level of education for caregivers was 13 years.

As for the low-vision patients, the average age was 73, and the majority (63.5%) were women. Half of the patients were married ($n = 48$; 50%) and approximately a third were widowed ($n = 34$; 35.4%). With regard to employment status, most (64.6%) were retired, 11 (11.5%) were disabled, 6 (6.3%) were unemployed, and 8 (8.3%) did not report employment status. The average level of education of the patients was 12 years ($SD = 3.48$).

In terms of vision-related characteristics, average visual acuity of patients (best corrected distance acuity in the better eye) was 0.74 logMAR (Snellen equivalent $\sim 20/110$). Age-related macular degeneration was most frequently the primary diagnosis ($n = 54$; 56.3%). Other causes of vision impairment were diabetic retinopathy, cerebral vascular accident, and glaucoma. The majority (68.8%) of patients reported experiencing gradual onset of vision loss, although almost 30% of the sample reported that vision loss was sudden. Patients reported an average of three comorbid chronic health conditions in addition to their vision impairment.

Prevalence of Caregiver Depressive Symptomatology

Table 2 shows a comparison of at-risk and nondepressed caregivers (61.5%) for patient and caregiver demographic variables, patient medical variables, and caregiver psychosocial variables. Three of the 96 caregivers had no data for this variable. Thirty-four (35.4%) family caregivers of individuals with visual impairments were identified as being at risk for depression (CES-D score ≥ 16). Caregivers at risk for depression were significantly younger ($P < 0.026$), caring for a relatively younger person with vision loss ($P < 0.024$), and providing assistance for a loved one with worse visual acuity ($P < 0.002$) compared with nondepressed caregivers. In addition, a greater proportion of female caregivers were identified as at risk for depression than were male caregivers.

The psychosocial characteristics of caregivers also varied between groups. Specifically, caregivers who were at risk for depression were less satisfied with life ($P < 0.001$) and reported greater caregiver burden ($P < 0.001$). At-risk caregivers also reported more ineffective or dysfunctional problem-solving abilities, greater negative orientation to solving problems ($P < 0.001$), lower positive problem orientation ($P < 0.003$), greater impulsivity/careless problem-solving style ($P < 0.006$), and a greater avoidant problem-solving style ($P < 0.004$) compared with nondepressed caregivers.

Predicting Caregiver Depressive Symptomatology

Table 3 contains the univariate correlations for the caregiver self-report measures of depressive symptoms, life satisfaction, caregiver burden, social problem-solving abilities, and caregiver and patient demographic/medical characteristics. Only significant correlations were entered into the prediction of caregiver depressive symptoms. Because depressive symptomatology and life satisfaction are highly correlated constructs, life satisfaction was not entered into the prediction of caregiver depression in an effort to minimize multicollinearity. Table 4 presents the depressive symptomatology model. The block of patient and caregiver demographic variables as well as psychosocial and medical variables (age of patient, patient depressive symptomatology, visual acuity, and sex and age of the caregiver) entered at the first step of the equation was significantly predictive of a caregiver's having depressive symptomatology ($F_{5,76} = 6.24$; $R^2 = 0.29$; $P < 0.001$). Younger age of the patient ($\beta = -0.21$; $t = -2.10$; $P = 0.039$), greater patient depressive symptomatology ($\beta = 0.28$; $t = 2.83$; $P = 0.006$), and women caregivers ($\beta = 0.23$; $t = 2.27$; $P = 0.026$) were all significantly associated with higher caregiver depression scores; patient visual acuity ($\beta = 0.16$; $t = 1.62$; NS) and caregiver age were not significant predictors ($\beta = -0.05$; $t = -0.49$; NS). At the second block, caregiver burden did not significantly augment the equation after controlling for patient and caregiver demographic variables ($F_{inc(1,75)} = 3.20$; $R_{inc}^2 = 0.03$; NS). However, the third block of caregiver problem-solving styles was significantly predictive of caregiver depressive symptomatology ($F_{inc(2,73)} = 8.80$; $R_{inc}^2 = 0.13$; $P < 0.001$). Caregiver avoidant style was associated with higher depression scores ($\beta = 0.34$; $t = 3.40$; $P < 0.001$) above and beyond patient and caregiver demographic variables, patient distress, and caregiver burden. At the final step, components of caregiver problem orientation further improved the model's ability to predict depressive symptomatology and accounted for an additional 14% of the variance ($F_{inc(2,71)} = 12.70$; $R_{inc}^2 = 0.14$; $P < 0.001$). A greater negative problem orientation ($\beta = 0.35$; $t = 3.20$; $P = 0.002$) and lower positive problem orientation ($\beta = -0.30$; $t = -3.42$; $P = 0.001$) were both associated with more caregiver depressive symptoms.

Predicting Caregiver Life Satisfaction

A second hierarchical regression equation was used to predict family caregivers' life satisfaction from caregiver and patient demographics, caregiver problem-solving style, and caregiver problem orientation. Table 4 presents the caregiver's life satisfaction model. As a group, patient and caregiver demographic variables (sex of the patient and caregiver and depressive symptomatology of the patient) added at the first step were significantly predictive of caregiver life satisfaction ($F_{3,82} = 9.36$; $R^2 = 0.26$; $P < 0.001$). Female patients ($\beta = 0.24$; $t = 2.32$; $P = 0.023$) and those with depressive symptomatology ($\beta = -0.40$; $t = -4.08$; $P < 0.001$) were both significantly associated with lower caregiver life satisfaction scores; the sex of the caregiver was not a significant predictor ($\beta = -0.11$; $t = -1.05$; ns). At the second step, caregiver burden significantly augmented the equation ($F_{inc(1,81)} = 8.27$; $R_{inc}^2 = 0.07$; $P = 0.005$), after controlling for patient and caregiver demographic variables. At the third step, caregiver avoidant style was not significantly predictive of caregiver life satisfaction ($F_{inc(1,80)} = 1.40$; $R_{inc}^2 = 0.01$; ns) above and beyond patient and caregiver demographic variables and caregiver burden. At the final step, components of caregiver problem orientation further improved the model's ability to predict the caregiver's satisfaction with life ($F_{inc(2,78)} = 9.22$; $R_{inc}^2 = 0.13$; $P < 0.001$). Inspection of the beta weights revealed that a caregiver's having greater negative problem orientation ($\beta = -0.31$; $t = -2.55$; $P = 0.013$) and lower positive problem orientation ($\beta = 0.27$; $t = 2.91$; $P = 0.005$) were both significantly associated with poorer satisfaction with life.

Discussion

A substantial number of individuals assisting a relative with adult-onset vision loss experience significant emotional distress. About one-third of the caregivers studied had depressive symptomatology suggestive of clinical depression. The prevalence of depressive symptoms reported by this sample was higher than expected compared with those in the general population⁵⁴ but was similar to those found among other caregiver populations caring for persons with long-term chronic health conditions (i.e., stroke, traumatic brain injury).^{18,34,35} The present study also revealed that several patient and caregiver demographic (i.e., age of patient and caregiver, and sex of patient), medical (i.e., patient visual acuity), and psychosocial variables (i.e., patient distress, caregiver burden, and caregiver problem-solving abilities) were related to caregiver well-being.

Family caregivers at risk for depression reported more dysfunctional problem-solving abilities (greater NPO, ICS, and AS) compared to caregivers of persons with vision impairments who were not at risk for depression. Consistent with the predictions of this study and with prior problem-solving research, problem orientation or motivation toward solving problems was significantly predictive of caregiver depressive symptomatology and life satisfaction after accounting for the variance attributed to patient visual acuity, patient age, caregiver sex, patient depressive symptomatology, and caregiver burden. Caregivers who have a greater negative orientation toward problem-solving in caring for persons with chronic health conditions are more likely to experience greater depressive symptomatology, distress, and other negative health outcomes.⁵⁵⁻⁵⁷ A greater negative orientation impairs problem-solving and adjustment by contributing to negative moods and inhibiting positive moods and by interfering with decision-making critical to effective problem-solving performance.^{22,58} Our data are consistent with earlier findings, in that caregivers who had a more negative problem orientation were more likely to report more depressive symptoms and less satisfaction with life than were those who reported a more positive approach to managing problems in daily living.

These results demonstrate the applicability of a problem-solving framework in understanding adjustment of family caregivers of persons with vision impairments. Caregivers who lack the problem-solving abilities necessary to balance caregiving responsibilities and personal well-being may compromise the health of both the caregiver and the person with the vision impairment. If undetected and untreated, negative outcomes related to caregiver distress may persist or worsen over time. We found a relationship between the emotional functioning of caregivers and their relatives with vision loss, as caregivers who reported greater depressive symptomatology also provided care for patients who reported greater depressive symptomatology. The relationship between patient- caregiver mood has been previously documented in the low vision literature¹⁶ as well as among other patient- caregiver populations (e.g., dementia).⁵⁹ Thus, further exploration of how the emotional well-being of individuals with vision loss and their caregivers may change across time appears warranted.

Eye care providers may vary in their awareness of the emotional consequences of vision loss on patients and the extent to which they integrate family members into vision care (e.g., treatment adherence, transportation to eye care appointments) and rehabilitation efforts (i.e., practice of therapeutic directives and appropriate use of devices within the home environment). Unfortunately, various obstacles, such as time constraints, focus on the patient, billing issues, lack of familiarity with treatment indications or medications, and/or resources prevent providers from screening and treating family members at risk for depression. Further complicating the provision of comprehensive vision care may be the ophthalmologist's lack of knowledge of vision rehabilitation resources, which would limit referrals to appropriate vision rehabilitation service providers.⁶⁰ Our results suggest that a significant number of family members assisting individuals with vision impairments experience emotional distress related

to their caregiving role. Encouragingly, psychosocial interventions, such as problem-solving training, may decrease caregiver distress by fostering a more efficient, systematic approach to caregiving that enhances motivation, knowledge about eye disease and the impact on quality of life, and self-efficacy when providing care for a relative with vision loss.

Evidence exists to support the efficacy of problem-solving training (PST) for caregivers.^{34, 35} PST has been successfully used to promote emotional and physical well-being, increase the use of active coping strategies, and treat depression. Problem-orientation components are particularly amenable to treatment and have been found to improve the quality of life of caregivers and patients with chronic health conditions. Psychosocial interventions that include education about eye diseases, increased access to community services and resources, low-vision rehabilitation efforts, support groups, home modifications, and treatment of depression may ultimately improve quality of life for patients with vision loss and their family members who provide ongoing assistance and support. Because caregiver and patient depressive symptomatology appear to be related, caregivers may benefit from education on how to support a loved one coping with vision loss. Integrating family members into psychosocial interventions aimed at optimizing patient well-being has shown benefits beyond patient-only interventions for a range of patient populations.⁶¹ The current authors are currently conducting a randomized clinical trial using PST, delivered specifically by occupational therapists, to persons with low vision. Until treatments and medical advancements to restore vision are available, the addition of psychosocial interventions in conjunction with current medical approaches (i.e., eye drops, surgery, and vitamins) may enhance quality of life and prevent negative outcomes for both patients and their family caregivers.

Our results underscore the need to consider the emotional impact of assisting a relative with vision loss. However, limitations must be acknowledged. CES-D scores alone cannot be used to determine whether an individual is experiencing clinical depression. Another limitation of the present study is that the cross-sectional design prohibits any causal conclusions, and it remains unclear whether it is the specific process of caring for a relative with vision loss that contributes to caregivers' distress. Longitudinal investigations are needed to better understand the relationship between caregiver demands (i.e., patient visual acuity, caregiver burden, and patient emotional distress) and caregiver adjustment to further determine the direction of this relationship. Although the study sample of caregivers was representative of persons presenting to this particular low-vision rehabilitation center, the sample consisted of only a small number of caregivers representative of different racial and ethnic backgrounds, which limits generalizability. Future studies addressing potential health disparities in persons presenting for low vision rehabilitation are needed, particularly as African-Americans are at greater risk for various eye diseases (i.e., glaucoma). Furthermore, individuals presenting to a low-vision rehabilitation center may be experiencing more functional impairments than those not seeking such services. Investigations examining differences in caregiver distress among individuals with vision loss who are/are not referred for vision rehabilitation are also needed. Another limitation in this study is that no information was collected on amount of time spent caregiving, which is important to evaluate in future studies to determine the specific tasks and time spent assisting individuals with such tasks. Last, caregiver medical and psychiatric histories were not assessed in this initial examination of caregiver adjustment. Such information would improve our understanding factors that influence adjustment to caring for a relative with vision loss and remains an area for future research.

In summary, the findings highlight the importance of understanding adjustment among family caregivers of persons with a vision impairment. As the U.S. population continues to age, the number of individuals living with vision loss is also expected to increase. Thus, it is likely that the number of family caregivers serving as informal extensions of the health-care system will also rise over the next several decades. Therefore, identifying caregivers who are at-risk for

depression and other negative outcomes is critical. Appropriate referral for treatment stands to enhance both patient and caregiver adjustment to vision loss. Problem-solving training may be especially useful for family members having difficulty coping with the challenges related to assisting a relative with vision loss.

Acknowledgments

The authors thank both the Clinical Research Unit and the Center for Low Vision Rehabilitation staff at the University of Alabama at Birmingham for their help in various aspects of the research.

Supported by Grant K23 EY017327-01 from the National Eye Institute (LED), the EyeSight Foundation of Alabama (ESFA; LED, CO), Research to Prevent Blindness Inc. (RPB), the Alfreda J. Schueler Trust, and Grant R21-EY14071 from the National Institutes of Health (CO).

References

1. Tielsch, J. Prevalence of visual impairment and blindness in the United States. In: Massof, R.; Lidoff, L., editors. *Issues in Low Vision Rehabilitation: Service Delivery, Policy, and Funding*. AFB Press; New York: 2001.
2. Vitale S, Cotch M, Sperduto R. Prevalence of visual impairment in the United States. *JAMA* 2006;295:2158–2163. [PubMed: 16684986]
3. Dreer L, Elliott T, Berry J, Fletcher D, Swanson M. Cognitive appraisal and emotional distress among persons in low vision rehabilitation. *Br J Health Psychol* 2008;13:449–461. [PubMed: 17535505]
4. Dreer, L.; Broadfoot, A. Lesson ten: evaluation and intervention for psychosocial issues. In: Warren, M., editor. *Revised Edition: Self-Paced Clinical Course in Low Vision*. American Occupational Therapy Association (AOTA); Bethesda, MD: 2008. p. 271-301.
5. Boerner K, Cimarolli VR. Optimizing rehabilitation for adults with visual impairment: attention to life goals and their links to well-being. *Clin Rehabil* 2005;19:790–798. [PubMed: 16250199]
6. Lamoureux E, Hassell J, Keefe J. The determinants of participation in activities of daily living in people with impaired vision. *Am J Ophthalmol* 2004;137:265–270. [PubMed: 14962415]
7. Owsley C, Stalvey B, Wells J, Sloane M, McGwin G. Visual risk factors for crash involvement in older drivers with cataract. *Arch Ophthalmol* 2001;119:881–887. [PubMed: 11405840]
8. Stevenson M, Hart P, Montgomery A, McCulloch D, Chakravarthy U. Reduced vision in older adults with age related macular degeneration interferes with ability to care for self and impairs role as carer. *Br J Ophthalmol* 2005;88:1125–1130. [PubMed: 15317701]
9. Travis L, Boerner K, Reinhardt J, Horowitz A. Exploring functional disability in older adults with low vision. *J Vis Impair Blind* 2004;98:534–545.
10. West S, Rubin G, Broman A, Munoz B, Bandeen-Roche K, Turano K. How does visual impairment affect performance on tasks of everyday life? *Arch Ophthalmol* 2002;120:774–780. [PubMed: 12049583]
11. O'Connor P, Lamoureux E, Keefe J. Predicting the need for low vision rehabilitation services. *Br J Ophthalmol* 2008;92:252–255. [PubMed: 18227205]
12. Cimarolli VR, Boerner K. Social support and well-being in adults who are visually impaired. *J Vis Impair Blind* 2005;99:521–534.
13. Reinhardt J. The importance of friendship and family support in adaptation to chronic vision impairment. *J Gerontol B Psychol Sci Soc Sci* 1996;51:268–278.
14. Reinhardt, J.; D'Allura, T. Social support and adjustment to vision impairment across the life span. In: Silverstone, B.; Lange, M.; Rosenthal, B.; Faye, E., editors. *The Lighthouse Handbook on Vision Impairment and Vision Rehabilitation*. Oxford University Press; New York: 2000. p. 1049-1068.
15. Schmier J, Halpern M, Covert D, Delgado J, Sharma S. Impact of visual impairment on use of caregiving by individuals with age-related macular degeneration. *Retina* 2006;26:1056–1062. [PubMed: 17151494]
16. Goodman CR, Shippey RA. Is it contagious?—affect similarity among spouses. *Aging Ment Health* 2002;6:266–274. [PubMed: 12217095]

17. Mcllvane J, Reinhardt J. Interactive effect of support from family and friends in visually impaired elders. *J Gerontol B Psychol Sci Soc Sci* 2001;56B:374–382.
18. Dreer L, Berry J, Elliott T, Rivera P. Characteristics of family caregivers of persons with spinal cord injury at risk for depression. *Rehabil Psychol* 2007;52:351–357. [PubMed: 18716667]
19. Elliott, T.; Schewchuk, R. Problem solving therapy for family caregivers of persons with severe physical disabilities. In: Radnitz, C., editor. *Cognitive-Behavioral Interventions for Persons with Disabilities*. Jason Aronson, Inc.; New York: 2000. p. 309-327.
20. Elliott T, Shewchuk R. Social problem-solving abilities and distress among family members assuming a caregiving role. *Br J Health Psychol* 2003;8:149–163. [PubMed: 12804330]
21. Kurylo M, Elliott T, DeVivo L, Dreer L. Caregiver social problem-solving abilities and family member adjustment following congestive heart failure. *J Clin Psychol Med Settings* 2004;11:151–157.
22. Elliott T, Shewchuk R, Richards J. Social problem solving abilities and adjustment during initial year of the caregiving career. *J Counsel Psychol* 2001;48:223–232.
23. Borg C, Hallberg IR. Life satisfaction among informal caregivers in comparison with non-caregivers. *Scand J Caring Sci* 2006;20:427–438. [PubMed: 17116152]
24. Brezin A, Lafuma A, Fagnani F, Mesbah M, Berdeaux G. Prevalence and burden of self-reported blindness, low vision, and visual impairment in the French community. *Arch Ophthalmol* 2005;123:1117–1124. [PubMed: 16087847]
25. Pinquart M, Sorensen S. Correlates of physical health of informal caregivers: a meta-analysis. *J Gerontol* 2007;62B:P126–P137.
26. Schulz R, Newsom J, Mittelmark M, Burton L, Hirsch C, Jackson S. Health effects study: an ancillary study of the Cardiovascular Health Study. *Ann Behav Med* 1997;19:110–116. [PubMed: 9603685]
27. Baider L, Bengel J. Cancer and the spouse: gender related differences in dealing with health care and illness. *Crit Rev Oncol Hematol* 2001;40:115–123. [PubMed: 11682318]
28. Pinquart M, Sorensen S. Differences between caregivers and non-caregivers in psychological health and physical health: a meta-analysis. *Psychol Aging* 2003;18:250–267. [PubMed: 12825775]
29. Yee J, Schulz R. Gender differences in psychiatric morbidity among family caregivers: a review and analysis. *Gerontologist* 2000;40:147–164. [PubMed: 10820918]
30. Hebert RS, Schulz R. Caregiving at the end of life. *J Palliat Med* 2006;9:1174–1187. [PubMed: 17040156]
31. Haley W, Roth D, Coletton M, et al. Appraisal, coping, and social support as mediators of well-being in black and white family caregivers of patients with Alzheimer's disease. *J Palliat Med* 2003;6:215–224. [PubMed: 12854938]
32. Dreer L, Elliott T, Fletcher D, Swanson M. Social problem-solving abilities and psychological adjustment of persons in low vision rehabilitation. *Rehabil Psychol* 2005;50:232–238.
33. Elliott, T.; Grant, J.; Miller, D. Social problem solving abilities and behavioral health. In: Chang, E.; D'Zurilla, T.; Sanna, L., editors. *Social Problem Solving: Theory, Research, and Training*. American Psychological Association; Washington, DC: 2004.
34. Rivera P, Elliott T, Berry JG. Problem-solving training for family caregivers of persons with traumatic brain injuries: a randomized controlled trial. *Arch Phys Med Rehabil* 2008;89:931–941. [PubMed: 18452743]JS
35. Grant J, Elliott T, Weaver M, Bartolucci A, Giger J. A telephone intervention with family caregivers of stroke survivors after rehabilitation. *Stroke* 2002;33:2060–2065. [PubMed: 12154263]
36. Bambara J, Wadley V, Owsley C, Martin R, Portern C, Dreer L. Family function and low vision: a systematic review. *J Vis Impair Blind*. In press
37. Cimarolli V. Perceived overprotection and distress in adults with visual impairment. *Rehabil Psychol* 2006;51:338–345.
38. Reinhardt J. Effects of positive and negative support received and provided on adaptation to chronic visual impairment. *Appl Dev Sci* 2001;5:76–85.
39. Reinhardt JP, Boerner K, Horowitz A. Good to have but not to use: differential impact of perceived and received support on well-being. *J Soc Pers Relat* 2006;23:117–129.

40. D’Zurilla, T.; Nezu, A.; Maydeu-Olivares, A. *Social Problem-Solving Inventory-Revised (SPSI-R): Manual*. Multi Health Systems; North Tonawanda, NY: 2002.
41. D’Zurilla T, Maydeu-Olivares A. Conceptual and methodological issues in social problem-solving assessment. *Behav Ther* 1995;26:409–432.
42. Radloff L. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;1:385–401.
43. Husaini B, Neff J, Harrington S, Hughes M, Stone R. Depression in rural communities: validating the CES-D scale. *J Commun Psychol* 1980;36:531–572.
44. Roberts R, Vernon S. The Center for Epidemiologic Studies Depression Scale: its use in a community sample. *Appl Psychol Meas* 1983;1:385–401.
45. Weissman M, Sholomskas D, Pottenger M, Prusoff B, Locke B. Assessing depressive symptoms in five psychiatric populations: a validation study. *Am J Epidemiol* 1977;106:204–214.
46. Roberts R. Reliability of the CES-D scale in different ethnic contexts. *Psychiatry Res* 1980;2:125–134. [PubMed: 6932058]
47. Ross C, Mirowsky J. Components of depressed mood in married men and women: The Center for Epidemiologic Studies’ Depression Scale. *Am J Epidemiol* 1984;119:997–1004. [PubMed: 6731436]
48. Turner J, Turner R. Physical disability, unemployment, and mental health. *Rehabil Psychol* 2004;49:241–249.
49. Fechner-Bates S, Coyne J, Schwenk T. The relationship of self-reported distress to depressive disorders and other psychopathology. *J Consult Clin Psychol* 1994;550–559. [PubMed: 8063981]
50. Diener E, Emmons R, Larsen R, Griffin S. The Satisfaction With Life Scale. *J Pers Assess* 1985;49:71–75. [PubMed: 16367493]
51. Oberst M, Thomas S, Gass K, Ward S. Caregiving demands and appraisal of stress among family caregivers. *Cancer Nurs* 1989;12:209–215. [PubMed: 2766264]
52. Ferris F, Kassoff A, Bresnick G, Bailey I. New visual acuity charts for clinical research. *Am J Ophthalmol* 1982;94:91–96. [PubMed: 7091289]
53. Ferris F, Sperduto R. Standardized illumination for visual acuity testing in clinical research. *Am J Ophthalmol* 1982;94:97–98. [PubMed: 7091290]
54. Gatz M, Hurwicz M. Are old people more depressed?—crosssectional data on Center for Epidemiological Studies Depression Scale factors. *Psychol Aging* 1990;5:284–290. [PubMed: 2378694]
55. Grant J, Elliott T, Weaver M, Glandon G, Raper J, Giger J. Social support, social problem-solving abilities, and adjustment to family caregivers of stroke survivors. *Arch Phys Med Rehabil* 2006;87:343–350. [PubMed: 16500167]
56. Grant J, Elliott T, Giger J, Bartolucci A. Social problem-solving abilities, social support, and adjustment among family caregivers of individuals with a stroke. *Rehabil Psychol* 2001;46:44–57.
57. Rivera P, Elliott T, Berry J, Grant J, Oswald K. Predictors of caregiver depression among community-residing families living with traumatic brain injury. *Neurorehabilitation* 2007;22:3–8. [PubMed: 17379944]
58. Shewchuk, R.; Elliott, T. Family caregiving in disability: implications for theory, practice, and policy. In: Frank, R.; Elliott, T., editors. *Handbook of Rehabilitation Psychology*. American Psychological Association; Washington, DC: 2000. p. 553–563.
59. Teri L, Logsdon R, Uomoto J, McCurry S. Behavioral treatment of depression in dementia patients: a controlled clinical trial. *J Gerontol B Psychol Sci Soc Sci* 1997;52:P159–P166. [PubMed: 9224439]
60. Greenblatt S. Physicians and chronic impairment: a study of ophthalmologists’ interactions with visually impaired blind patients. *Soc Sci Med* 1988;26:393–399. [PubMed: 3363390]
61. Martire L. The “relative” efficacy of involving family in psychosocial interventions for chronic illness: are there added benefits to patients and family members? *Fam Sys Health* 2005;23:312–328.

Table 1**Demographic and Medical Characteristics of the Caregivers and Patients with Low Vision**

Characteristic	Caregivers	Patients
Age (y), mean (SD)	58.64 (13.81)	73.48 (13.87)
Highest level of education (y), mean (SD)	13.76 (2.65)	12.32 (3.48)
Sex, <i>n</i> (%)		
Women	68 (70.8)	61 (63.5)
Men	28 (29.2)	35 (36.5)
Race/ethnicity, <i>n</i> (%)		
Caucasian	87 (90.6)	85 (88.5)
African-American	8 (8.3)	10 (10.4)
Asian	1 (1.0)	1 (1.0)
Marital status, <i>n</i> (%)		
Married	70 (72.9)	48 (50.0)
Widowed	4 (4.2)	33 (34.4)
Divorced	9 (9.4)	6 (6.3)
Single	7 (7.3)	0 (0)
Separated	1 (1.0)	0 (0)
Missing data	5 (5.2)	7 (7.3)
Employment status, <i>n</i> (%)		
Employed	46 (47.9)	8 (8.3)
Unemployed	24 (25.0)	6 (6.3)
Retired	20 (20.8)	64 (66.7)
Disabled	0 (0)	11 (11.5)
Missing data	6 (6.3)	7 (7.3)
Caregiver relationship to the patient, <i>n</i> (%)		
Spouse	36 (37.5)	
Daughter	32 (33.3)	
Son	8 (8.3)	
Mother	5 (5.0)	
Sister	3 (3.1)	
Daughter-in-law	3 (3.1)	
Brother	3 (3.1)	
Nephew	2 (2.1)	
Granddaughter	1 (1.0)	
Niece	1 (1.0)	
Son-in-law	1 (1.0)	
Unknown	1 (1.0)	
Best corrected distance visual acuity (logMAR), mean (SD)		0.74 (0.40)
Total number of comorbid chronic health conditions, mean (SD)		2.79 (1.68)
Patient primary vision diagnosis, <i>n</i> (%)		
Age-related macular degeneration		54 (56.3)
Diabetic retinopathy		8 (8)
Glaucoma		8 (8)
Other vision impairments (e.g., retinitis pigmentosa)		21 (22)
Vision impairment of unknown origin		1 (1)

Table 2

Comparison of Caregivers at Risk for Depression and Nondepressed Caregivers on Caregiver Demographics, Patient Medical Characteristics, and Caregiver Psychosocial Variables

Characteristic	At Risk for Depression (n = 34)	Nondepressed (n = 59)	P	Total Sample (n = 96)
Caregiver age (y), mean (SD)	53.97 (14.57)	60.59 (12.85)	0.026 [*]	58.64 (13.81)
Caregiver highest level of education (y), mean (SD)	13.38 (2.47)	14.00 (2.78)	0.286	13.76 (2.66)
Caregiver sex, n (%)			0.002 [†]	
Women	31 (91.2)	36 (61)		68 (70.8)
Men	3 (8.8)	23 (39)		28 (29.2)
Caregiver race/ethnicity, n (%)			0.257	
Caucasian	27 (79.4)	57 (96.6)		87 (90.6)
African-American	7 (20.6)	1 (1.7)		8 (8.3)
Asian	0 (0)	1 (1.7)		1 (1.0)
Caregiver marital status, n (%)			0.131	
Married	20 (58.8)	47 (79.7)		70 (72.9)
Widowed	2 (5.9)	2 (3.4)		4 (4.2)
Divorced	5 (14.7)	4 (6.8)		9 (9.4)
Single	4 (11.8)	3 (5.1)		7 (7.3)
Separated	1 (2.9)	0 (0)		1 (1.0)
Missing data	2 (5.9)	3 (5.1)		5 (5.2)
Caregiver employment status, n (%)			0.594	
Employed	18 (52.9)	28 (47.5)		46 (47.9)
Unemployed	12 (35.3)	12 (20.3)		24 (25.0)
Retired	2 (5.9)	15 (25.4)		20 (20.8)
Disabled	0 (0)	0 (0)		0 (0)
Missing data	2 (5.9)	4 (6.8)		6 (6.3)
Caregiver relationship to the patient, n (%)			0.772	
Spouse	9 (26.5)	24 (40.7)		36 (37.5)
Daughter	14 (41.2)	18 (30.5)		32 (33.3)
Son	1 (2.9)	7 (11.9)		8 (8.4)
Mother	4 (11.8)	1 (1.7)		5 (5.2)
Sister	1 (2.9)	2 (3.4)		3 (3.1)
Daughter-in-law	2 (5.9)	1 (1.7)		3 (3.1)
Brother	1 (2.9)	2 (3.4)		3 (3.1)
Nephew	1 (2.9)	1 (1.7)		2 (2.1)
Granddaughter	0 (0)	1 (1.7)		1 (1.0)
Niece	0 (0)	1 (1.7)		1 (1.0)
Son-in-law	0 (0)	1 (1.7)		1 (1.0)
Unknown	1 (2.9)	0 (0)		1 (1.0)
Patient best corrected distance visual acuity (logMAR), mean (SD)	0.899 (0.405)	0.622 (0.337)	0.002 [†]	0.736 (0.386)
Total number of comorbid health conditions, mean (SD)	2.74 (1.76)	2.78 (1.66)	0.904	2.79 (1.68)
Patient primary eye diagnosis, n (%)			0.959	
Age-related macular degeneration	16 (47.1)	36 (61.0)		54 (56.3)
Diabetic retinopathy	5 (14.7)	1 (1.7)		7 (7.3)
Glaucoma	2 (5.9)	2 (3.4)		4 (4.2)
Other (e.g., RP, birdshot chorioidopathy)	11 (32.0)	19 (32.3)		30 (30.6)
Vision impairment with unknown etiology	0 (0)	1 (1.7)		1 (1.0)
Caregiver psychosocial variables, mean (SD)				
Depressive symptoms (CES-D score)	23.18 (6.96)	7.32 (4.44)	<0.001 [†]	13.12 (9.42)
Satisfaction with life (SWLS score)	18.28 (7.41)	28.77 (6.16)	<0.001 [†]	24.98 (8.37)
Caregiver burden (CBS score)	27.16 (9.90)	22.73 (8.81)	0.033	24.24 (9.32)
Social problem-solving abilities				
Negative problem-orientation (NPO score)	8.76 (5.02)	4.00 (2.85)	<0.001 [†]	5.58 (4.40)

Characteristic	At Risk for Depression (<i>n</i> = 34)	Nondepressed (<i>n</i> = 59)	<i>P</i>	Total Sample (<i>n</i> = 96)
Positive problem-orientation (PPO score)	11.85 (4.06)	14.44 (3.78)	0.003 [†]	13.35 (4.09)
Rational problem-solving style (RPS score)	11.64 (3.44)	11.67 (4.25)	0.967	11.53 (4.00)
Impulsive/carelessness style (ICS score)	7.06 (3.30)	4.81 (3.84)	0.006 [‡]	5.62 (3.75)
Avoidant style (AS score)	6.27 (4.42)	3.86 (3.24)	0.004 [‡]	4.65 (3.85)

* Statistically significant (*P* < 0.05).
[†] Statistically significant (*P* < 0.01).
[‡] Statistically significant (*P* < 0.001).

Correlations for Caregiver Depressive Symptoms, Life Satisfaction, Social Problem-Solving Abilities, and Caregiver/Patient Demographic Variables

Table 3

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. C-CES-D	—															
2. C-SWLS	-0.72 [*]	—														
3. C-CBS	0.25 [†]	-0.32 [*]														
4. C-PPO	-0.54 [*]	0.47 [*]	—													
5. C-NPO	0.65 [*]	-0.55 [*]	0.37 [*]	—												
6. C-RPS	-0.17	0.03	0.12	-0.37 [*]	—											
7. C-ICS	0.33 [*]	-0.20	0.13	-0.11 [*]	0.01	—										
8. C-AS	0.44 [*]	-0.26 [†]	0.08	-0.29 [*]	0.56 [*]	-0.19	—									
9. C-sex	0.29 [*]	-0.26 [†]	0.01	-0.09	0.26 [†]	0.06	0.01	—								
10. C-age	-0.23 [†]	0.17	-0.18	-0.02	-0.17	-0.18	-0.06	0.01	—							
11. P-CESD	0.32	-0.42 [*]	0.16	-0.25 [†]	0.27 [†]	-0.10	0.14	0.16	0.15	—						
12. P-sex	-0.19	0.25 [†]	-0.02	0.06	-0.32 [*]	-0.04	-0.15	-0.20 [†]	-0.34 [*]	-0.02	—					
13. P-age	-0.26 [†]	0.20	-0.12	0.11	-0.29 [*]	0.04	-0.14	-0.10	-0.03	0.25 [†]	0.24 [†]	—				
14. P-onset	0.03	0.01	0.10	-0.04	0.02	0.04	0.09	0.02	0.12	-0.17	-0.20	0.04	—			
15. P-visual acuity	0.22 [†]	-0.19	0.15	-0.02	0.12	0.05	0.08	-0.10	0.13	-0.24 [†]	0.04	-0.01	0.22 [†]	—		
16. P-number of health problems	-0.02	-0.08	-0.05	-0.07	-0.10	0.12	-0.09	-0.14	-0.05	0.03	-0.10	0.01	0.30 [*]	0.10	-0.05	—

Onset, 1 = gradual versus 0 = sudden vision loss; visual acuity, best corrected distance acuity in the better eye-logMAR scores; sex, sex of participant (0 = male, 1 = female); C, caregiver variables; P, patient variables.

^{*} Statistically significant ($P < 0.01$).

[†] Statistically significant ($P < 0.05$).

Table 4

Results of Multiple Regression Analyses of Caregiver and Patient Demographic Data, Caregiver Burden, and Caregiver Social Problem-Solving Abilities on Caregiver Depressive Symptoms and Satisfaction with Life

Variable	R^2	R_{inc}^2	β	F_{inc}	P
Caregiver Depressive Symptoms					
Step 1	0.29			6.24	
P-age			-0.21		<0.001 [*]
Best corrected distance acuity in better eye, logMAR			0.16		0.04 [†]
P-CES-D			0.28		0.11
C-sex			0.23		0.01 [†]
C-age			-0.05		0.03 [†]
Step 2	0.32	0.03		3.20	0.63
Caregiver burden (CBS score)			0.18		0.08
Step 3	0.45	0.13		8.80	0.08
Impulsive/careless style (ICS score)			0.07		<0.001 [*]
Avoidant style (AS score)			0.34		0.52
Step 4	0.60	0.14		12.70	0.001 [†]
Negative problem orientation (NPO score)			0.35		<0.001 [*]
Positive problem orientation (PPO score)			-0.30		0.001 [†]
Caregiver Satisfaction with Life					
Step 1	0.26			9.36	0.001 [*]
P-sex			0.24		<0.001 [†]
P-CES-D			-0.40		0.02 [†]
C-sex			-0.11		<0.001 [*]
Step 2	0.32	0.07		8.27	0.30
Caregiver burden (CBS score)			-0.26		0.01 [†]
Step 3	0.34	0.01		1.40	0.01 [†]
Avoidant style (AS score)			-0.11		0.24
Step 4	0.46	0.13		9.22	0.24
Negative problem orientation (NPO score)			-0.31		<0.001 [*]
Positive problem orientation (PPO score)			0.27		0.01 [†]

Sex, sex of participant (0 = male, 1 = female); C, caregiver variables; P, patient variables.

^{*} Statistically significant ($P < 0.001$).

[†] Statistically significant ($P < 0.05$).

[‡] Statistically significant ($P < 0.001$).