JVIB

February 2007 • Volume 101 • Number 2

Clinical Assessment of Functional Movement in Adults with Visual Impairments

Christopher T. Ray, Michael Horvat, Michael Williams, and Bruce B. Blasch

Adults with visual impairments (that is, those who are blind or have low vision) have significantly more health risks than do sighted adults because of a number of factors, including the lower mineral density of their femoral neck bones, which is indicative of reduced weight-bearing exercise; their lesser maximal strength; and their higher rates of stroke, osteoporosis, depression, hypertension, heart disease, arthritis, diabetes, and falls (Crews & Campbell, 2001; Uusi-Rasi, Sievanen, Rinne, Oja, & Vuori, 2001). A contributing factor is that individuals who are visually impaired are less physically active than are sighted individuals (Crews & Campbell, 2001). These factors play a significant role in the quality of life of persons who are visually impaired and can affect their independent movement. The physiological changes in addition to the loss of vision to preview the environment can result in decreased movement and increased restrictions on movement.

This study was funded by the Department of Rehabilitation Research and Development, Department of Veterans Affairs, Atlanta, GA. The authors give special thanks to William De l'Aune for his statistical support.

During the aging process, balance and overall mobility are affected as people lose some of their ability to use vision, proprioception, and vestibular information (Lusardi, Pellecchia, & Schulman, 2003). However, the movement of individuals who are visually impaired may diminish much earlier because of changes in behavior (the adoption of a more sedentary lifestyle); if these changes in behavior are not reversed, they could lead to a reduced quality of life as the individuals continue to age and experience a greater incidence of falls or frailty late in life. The relationship or impact of the visual, somatosensory (proprioceptive), and vestibular systems on mobility for these individuals has not been sufficiently addressed. The purpose of this investigation was to investigate the movement of adults with visual impairments using two common clinical measures to gain a better understanding of the impact of vision loss on movement and health in adults who are visually impaired. Documentation of this information is an important step in understanding the functional limitations resulting from vision loss and the eventual development of interventions and rehabilitation programs to remediate those limitations.

METHOD

Participants

The 15 participants with visual impairments aged 20-58 were matched with 15 sighted adults by age and gender. Their visual acuity equaled or exceeded the U.S. definition of legal blindness. The participants demonstrated variability in the degree, etiology, and age of onset of their vision loss. As a group, they were active--that is, independent (all were able to travel independently with long canes) and proficient in their ability to move within their environment.

The participants' visual status was divided into low, medium, and high on the basis of their level of visual functioning, which is consistent with the classification used for athletes who are blind (United States Association of Blind Athletes, 2006). The four participants in the B1 category had no light perception, the nine participants in the B2 category had the ability to see light and shapes and an acuity of up to 20/600 and a visual field of less than 5 degrees, and the two participants in the B3 category were able to recognize hand movements up to and including 20/200 acuity and had a visual field of up to 20 degrees. Demographic profiles of the participants are presented in Table 1, and data on the individual participants are presented in Table 2.

Procedures

Prior to testing, all the procedures were explained to and practiced with the participants, so they had a clear understanding of the requirements of the tasks and had the best opportunity to complete the trials successfully. Consent was obtained from each participant, and the protocol used was approved by the University of Georgia institutional review board.

The timed up-and-go and 30-second sit-to-stand protocols were used for this study. The timed up-and-go test, which was performed to assess functional balance, mobility, and strength, is often used by clinicians because it is easy to administer, low in cost, and functionally relevant. During this task, the participants, who were seated in a chair next to a wall, were asked to rise from the chair to a standing position without the use of their arms, to walk 3 meters (about 10 feet) while trailing a wall with their hand, to turn around at the end of the wall, and then to return to a seated position in the chair. Velcro strips were attached to the wall approximately 12-18 inches from the chair to serve as a "prompt" that the chair was nearby. The participants were instructed to perform this task at a safe pace, but were told that their time was recorded. Three trials for each participant were performed. The time for completion of each trial was recorded on a stopwatch to the nearest 0.01 second.

The 30-second sit-to-stand test was performed using a 17-inch-high padded chair without armrests. The chair was positioned against a wall to maintain stability, and a researcher was positioned to the side of the participant to ensure the participant's safety (Weiner, Long, Hughes, Chandler, & Studenski, 1993).

During the trial, the participants rose to a full standing position and then returned to a seated position as many times as possible in 30 seconds. At the end of the 30-second trial, if a participant was more than halfway to a full standing position, it was counted as a full repetition (Jones, Rikli, & Beam, 1999).

RESULTS

Although the participants were matched by age and gender to eliminate variability in the sample, notable differences were evident in the body weight and body mass index (BMI) of the visually impaired and sighted groups. To address the large number of variables, a one-way analysis of variance (ANOVA) was performed to determine significant between-group differences (Cohen, 1988). The ANOVA yielded no significant differences ($p > .05$) in weight or height, but significant differences between groups were apparent in BMI, $F(1, 28) = 5.69$, $p = .024$. To control for this difference, BMI was used as a covariate in subsequent group analyses.

An analysis of covariance (ANCOVA) was used to analyze the group differences, with each participant's mean time for the timed up-and-go task with BMI as a covariate. Statistically significant differences between the groups were evident, $F(2, 27) = 4.537$, $p = .02$. The participants who were visually impaired required more time (7.99 seconds, $SD = 3.86$) than those who were sighted (4.86 seconds, $SD = .84$) to complete the task of standing up, walking 3 meters, turning around, and returning to the seated position. During the 30-second sit-to-stand task, the maximum number of repetitions for each participant was recorded, and group differences were examined using an ANCOVA with BMI as the covariate. Significant differences between the groups were found, $F(2, 27) = 4.65$, $p = .018$. The mean number of repetitions for the visually impaired group was 16.87 ($SD = 5.94$), compared to 23.00 ($SD = 8.22$) for the sighted group.

A Spearman's rho correlation was calculated to determine the relationship between the visual classification of the particpants and their BMI, the timed up-and-go task, and the 30-second sit-to-stand task. A negative correlation was found between BMI and visual classification (r = -.708, p <.01) and the timed up-and-go task and visual classification (r = -.397, p = .030). No significant difference was found between visual classification and the 30-second sit-to-stand task. This inverse relationship suggests that the more restricted an individual's vision becomes, the more the person's BMI will increase, along with the time it takes to complete the timed up-and-go task.

DISCUSSION

Implications

During the sit-to-stand task, all the participants could perform the components of the task, regardless of their visual status. However, the inability to perform the task quickly and repeatedly indicates that the underlying components of strength and balance appear to be lower in individuals who are visually impaired. This finding supports previous research that found that lower levels of muscular strength and balance may be suitable predictors of declining mobility skills and instability of movements in unstable environments, such as walking on gravel or slippery surfaces (Horvat, Ray, Croce, & Blasch, 2004; Horvat et al., 2003; Ray, Horvat, Keen, & Blasch, 2005).

That the sighted participants were able to respond faster than those who were visually impaired during the timed up-and-go trials indicates that the visually impaired group had difficulty with fast-paced movements. It is important to note that Lusardi et al. (2003) found that sighted participants aged 60-69 performed the timed up-and-go task in 7.9 seconds, similar in time to our sample, even though the mean age of the visually impaired group was 38. Thus, the findings of this study support the view that vision loss has an impact on physiological changes that affect movement, strength, and overall health.

The most troubling finding was the relationship between visual impairment and the increased risk of chronic disease, as determined by the correlation between visual classification and BMI. This observation implies that greater vision loss results in a greater risk of obesity, prevalence of chronic health conditions, and premature mortality. Following this logic, the prevalence of disease, which is strongly associated with obesity, is greater for individuals who are visually impaired. It further suggests that visual impairment, obesity, and related chronic diseases have a cyclical relationship that reinforces the effects of ill health and appears to increase the risk of premature mortality.

LIMITATIONS

Although the variability of the participants' visual status may be viewed as a limitation, this was a preliminary study to determine if the movement of persons who are visually impaired is affected on two commonly used clinical measures. We acknowledge that it may have been more appropriate to analyze the data using subgroups of individuals with visual impairments; however, the small sample and nonequivalent group sizes prevented analyses of subgroups.

CONCLUSION

On the basis of the findings of this study, we conclude that individuals who are visually impaired have an increased risk of chronic health problems and difficulty with functional mobility tasks that require strength and speed. Although deficiencies in function are not general consequences of visual impairment, as measured by the 30-second sit-to-stand and timed up-and-go tasks, they may be indicative of an inactive lifestyle and lack of physical functioning because of reduced independence after the onset of vision loss. Future work should investigate activities that increase functional strength and participation by individuals with visual impairments. These findings point to the need for accessible physical activity programs that promote greater overall health and strength for individuals who are visually impaired. The reduction in physical functioning, coupled with the relationship between reduced vision and increased BMI among visually impaired individuals, provides a compelling rationale for future research on the implementation of activity programs that target visually impaired individuals. This finding has great potential to facilitate mobility and to provide clinical approaches that reduce the risk of chronic disease.

References

Cohen, J. (1988). *Statistical power analysis* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Crews, J. E., & Campbell, V. A. (2001). Health conditions, activity limitations, and participation restrictions among older people with visual impairments. *Journal of Visual Impairment & Blindness, 95,* 453-467.

Horvat, M., Ray, C., Croce, R., & Blasch, B. (2004). A comparison of isokinetic muscle strength and power in visually impaired and sighted individuals. *Isokinetics and Exercise Science, 12,* 179-183.

Horvat, M., Ray, C., Ramsey, V. K., Miszko, T., Keeney, R., & Blasch, B. B. (2003). Compensatory analysis and strategies for balance in individuals with visual impairments. *Journal of Visual Impairment & Blindness, 97,* 695-703.

Jones, C. J., Rikli, R. E., & Beam, W. C. (1999). A 30-s chair stand test as a measure of lower body strength in community-residing older adults. *Research Quarterly for Exercise and Sport, 70,* 113-119.

Lusardi, M. M., Pellecchia, G. L., & Schulman, M. (2003). Functional performance in community living older adults. *Journal of Geriatric Physical Therapy, 26,* 14-22.

Ray, C., Horvat, M., Keen, K., & Blasch, B. (2005). Using tai chi as an exercise intervention for improving balance in adults with visual impairments: Two case studies. *RE:view, 37*, 17-24.

United States Association of Blind Athletes. (2006, June). IBSA visual classifications. [Online.] Retrieved November 28, 2006, from http://www.usaba.org/Pages/sportsinformation/visualclassifications.html

Uusi-Rasi, K., Sievanen, H., Rinne, M., Oja, P., & Vuori, I. (2001). Bone mineral density of visually handicapped women. *Clinical Physiology, 21*, 498-503.

Weiner, D. K., Long, R., Hughes, M. A., Chandler, J., & Studenski, S. (1993). When older adults face the chair rise challenge. *Journal of the American Geriatric Society, 41*, 6-10.

Christopher T. Ray, Ph.D., ATC, CSCS, *research fellow, Rehabilitation Research & Development Center (151R), Atlanta VA Medical Center, 1670 Clairmont Road, Decatur, GA 30033; e-mail: <RAYuga@aol.com>.* ***Michael Horvat, Ed.D.,*** *professor, Department of Physical Education and Sport Science, University of Georgia, 323 Ramsey, Athens, GA 30602; e-mail: <horvat@uga.edu>.* ***Michael Williams, Ph.D.,*** *research scientist, Rehabilitation Research & Development Center (151R), Atlanta VA Medical Center; e-mail: <ike.williams2@med.va.ga>.* ***Bruce B. Blasch, Ph.D.,*** *research health scientist, Rehabilitation Research & Development Center (151R), Atlanta VA Medical Center; e-mail: <earconsul@aol.com>.*

Download braille-ready file

Download ASCII text file (ASCII files are for download only)

Download PDF file

Previous Article | Next Article | Table of Contents

Search JVIB | **JVIB Policies** | **Contact JVIB** | **Subscriptions** | **JVIB Home**

If you would like to give us feedback, please contact us at jvib@afb.net.

\t

www.afb.org | **Change Colors and More** | **Contact Us** | **Site Map** |

Site Search Go

About AFB | **Press Room** | **Bookstore** | **Donate** | **Policy Statement**

Please direct your comments and suggestions to afbinfo@afb.net