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Original Research

Acute and Chronic Injury in Individuals with Visual Impairments Using Dog Guides

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Abstract

Introduction: Previous studies of individuals with visual impairment (iVI) using dog guides reported greater perceived freedom of mobility compared to alternative mobility aids. This study evaluates the effect of dog guides on falls in iVI, and how dog guide use affects the user's acute and chronic musculoskeletal health.

Methods: We conducted an online survey with 80 completed responses from iVI currently using a dog guide. Survey questions were assessed by iVI reviewers to be appropriate for survey users. Respondents ranged from 18 to over 70 years of age, with 58% under age 40. Seventy-four percent of respondents were female, 19.5% totally blind, 55.8% legally blind, 19.5% reported only light perception, and 5.2% reported as

visually impaired. Participants had used dog guides for an average of 5 years (range: 1 to > 20 years).

Results: Dog guide use significantly decreased the number and severity of falls, compared to other mobility aids ($p<0.01$, $n=80$). Falls that did occur had a significantly lower incidence of fracture ($p<0,05$, $n=80$). However, dog guide users reported increased musculoskeletal pain after beginning dog guide use ($p<0.05$, $n=80$), with a significant increase in left shoulder pain ($p<0.05$, $n=59$), the side in which 96% of respondents handled their dog guide.

Discussion: We propose that dog guide use benefits iVI by reducing a risk of injuries due to falls, there exists a potential for chronic injuries to the shoulder that handles the dog guide harness, likely due to continual force on the shoulder by connection to the dog guide.

Implications for Practitioners: Walking with a dog guide has potentially adverse effects on users, including altered gait, altered posture, and chronic accelerating forces on the arm holding the handle of the harness. Clinicians should be alert to potential trauma or damage to musculoskeletal structures due to these forces.

Introduction

The National Health Interview Survey of 2018 indicated there are 32.2 million Americans, age 18 and older, living with vision loss (National Health Interview Survey, NHIS, 2018). Disruption of independent mobility outside of the home is one of the most significant impairments resulting from loss of vision (Gitlin, Mount, Lucas, Weirich, & Gramberg, 1997). To combat both isolation and injury, people who are visually impaired may utilize a limited number of mobility aids to navigate their environment including sighted guides, long canes, and dog guides. Persons with visual impairments who are dog guide users were more independent than non-users, with 88% reporting total independence compared to 60% using other mobility aids (Refson, Jackson, Dusoir & Archer, 1999).

Only 2 to 8 percent of people with visual impairment use a dog guide to improve their mobility and independence (National Federation for the Blind, 2017). Dog guides enable most individuals with visual impairment to better self-navigate, be more independent, and markedly improve their quality of life (Whitmarsh, 2009). Dog guide users stated that their overall quality of life improved significantly after getting their guide dog (Refson, et al 1999). Quality of life indicators reported were: increased independence, mobility, companionship, social contact, self-confidence, physical fitness, and self-esteem (Gitlin et al. 1997; Refson et al., 1999).

Independent mobility relates to multiple challenges, beyond simply finding their way to a destination. One of the most serious challenges is the threat of injuries by individuals with visual impairment due to falls (Manduchi & Kurniawan, 2011; Schieppati, Schmid & Sozzi, 2014). Visual impairment increases one's risk of falling or colliding with objects. Manduchi and Kurniawan (2011) investigated the frequency, nature, and causes of falls and "head level" accidents in 300 legally blind or blind individuals who used long canes or dog guides as travel aids. Other factors assessed included level of blindness, and the frequency of independent trips taken by the participants. They concluded that the use of mobility aids did not significantly affect the frequency of falls or head level accidents in visually impaired individuals (Manduchi & Kurniawan, 2011).

Other than falls, other types of injuries specific to dog guide use have not been widely studied. Refson et al. reported that visually impaired dog guide users were, on average, significantly younger than non-dog guide users (Refson et al., 1999). Also, dog guide users were more likely to have been visually impaired from an early age, and suffer from additional concurrent health issues. Cardiovascular problems, arthritis, and respiratory conditions were reported in 66% of guide dog users. Most stated these health issues did not severely limit their mobility (Refson et al., 1999).

The present study suggests a reduction in acute injuries due to falls; however, we have questioned whether there may be chronic injuries associated with the use of dog guides. Holding the harness asymmetrically likely has a chronic effect on posture and

gait, and may result in chronic injuries (Zabihaylo, Couturier, Termoz & Prince, 2005). There have been few studies examining musculoskeletal complaints and their correlation to dog guide use. The physical connection of dog guide to user through the harness is integral to communication between human and dog, resulting in constant tension transmitted through the handle of the harness. Mount et al. (1997) studied 21 dog guide users, and reported that "person's assisted by dogs complained of shoulder, wrist, and back pain." However, those authors reported that participants in that study denied, ignored, or minimized negative physical effects from travel aid use, apparently for fear that their dog would be viewed negatively. Out of 38 musculoskeletal complaints presented in that study, 44% were in an upper extremity; 34% were trunk based; 15% related to overall physical well-being; and 7% on the lower extremity (Mount, Gitlin & Howard, 1997).

Due to the nature of the forces and constantly changing acceleration in the dog/user physical connection through the handle attached to the harness, it seems likely that there may be a musculoskeletal impact on the human body of the dog guide user resulting in acute and/or chronic musculoskeletal injuries. These issues have not been well studied in persons with visual impairments that utilize travel aids. In the present work, we report results from a survey of 80 dog guide users where we examine the effects of dog guide use on the quality of life. The survey examines whether dog guide use may result in a decrease in the number of falls, and relate to complaints of chronic injuries.

Methods

The survey instrument was designed by faculty and students of the Department of Physical Therapy at the University of North Georgia and consisted of 27 queries with either multiple choice or open-ended responses. Appropriateness of survey questions for vision-impaired subjects was confirmed by an expert panel consisting of one dog guide handler with total blindness, one dog guide handler declared legally blind, and one dog guide handler with only light perception. The survey was conducted online using a free software product (surveymonkey.com) in December 2016. The survey was distributed

through the Guide Dog Handlers Network Group on Facebook, and reflects results from guide dog users in mostly rural north Georgia. The online survey and informed consent document were approved by the University of North Georgia Institutional Review Board. Following online informed consent, survey data was recorded without identity references to those surveyed to protect confidentiality. We estimate the completion rate of survey at approximately 10%. This response rate is likely low due to the fact that respondents are visually impaired will likely limit the frequency of their access to Facebook postings.

Qualitative data was coded by a team of three individuals, based on a rubric developed by the research group, with the assistance of a biostatistician. Results of the coded data were analyzed by Pearson's chi square frequency analysis or Chi square goodness-of-fit (Steel & Torrie, 1960; Milton, 1999). Data are reported either as tabulated frequency or as a percentage of those responding to the particular question, as indicated.

Results

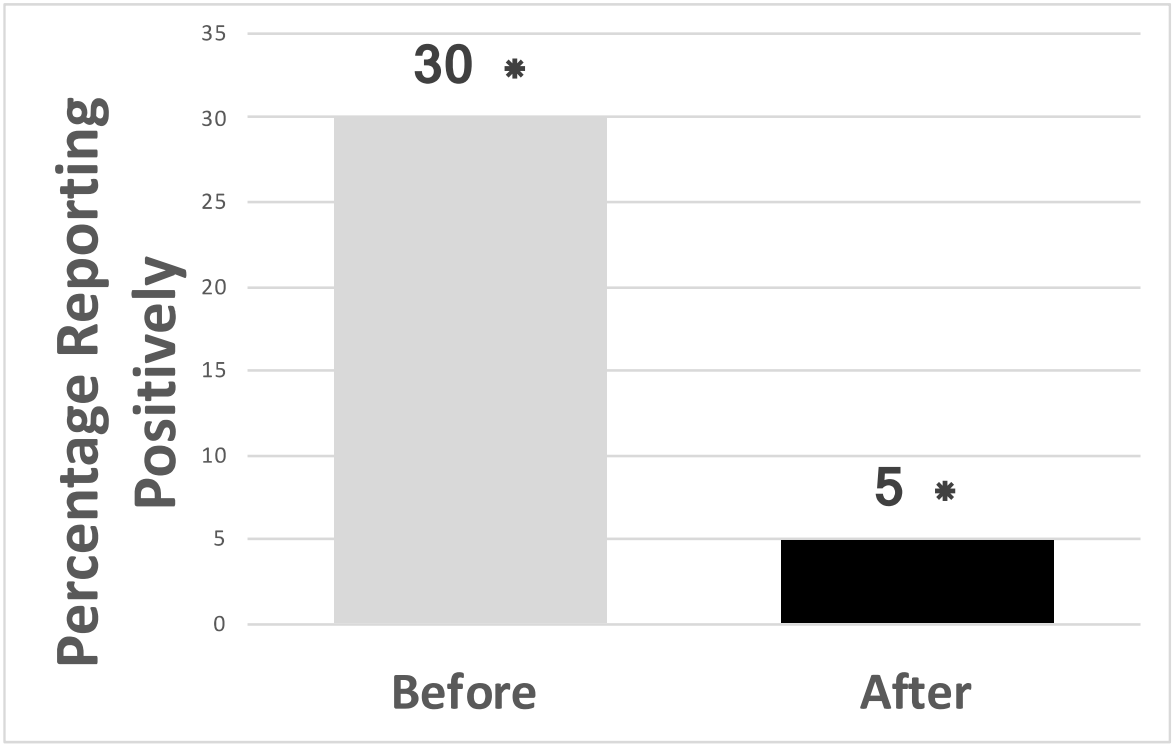
Eighty volunteer participants completed the survey. Respondents ranged from 18 to over 70 years of age (YO), with 40% (n=32) being less than 30 YO and 58% (n=46) under 40 YO. Females were 74% (n=59) of respondents. Only one respondent (1.3%) reported manual labor as an occupation. The majority were involved in work requiring minimal physical activity, including office workers, students, and those currently unemployed. The reported visual status of the respondents was 20% (n=16) totally blind, 56 %(n=45) legally blind, 19% (n=15) report only light perception, and 5% (n=4) reported themselves as visually impaired.

Participants in this study had used dog guides for a median time of 5 years (range of less than 1 year to greater than 20 years). Before using a guide dog, the majority of respondents (81%, n=65). reported using a long cane as a mobility aid The remaining respondents, 19% (n=15), used a variety of means of navigating including limited use of long canes, sighted guides, and only going to familiar locations.

The use of a dog guide reduced the risk of falling in individuals who are visually impaired. Our data suggests that the percentage of individuals who are visually impaired reported frequent falling significantly less after beginning to use a dog guide as a mobility aid ($p<0.05$, $n=80$) (Figure 1).

Figure 1.

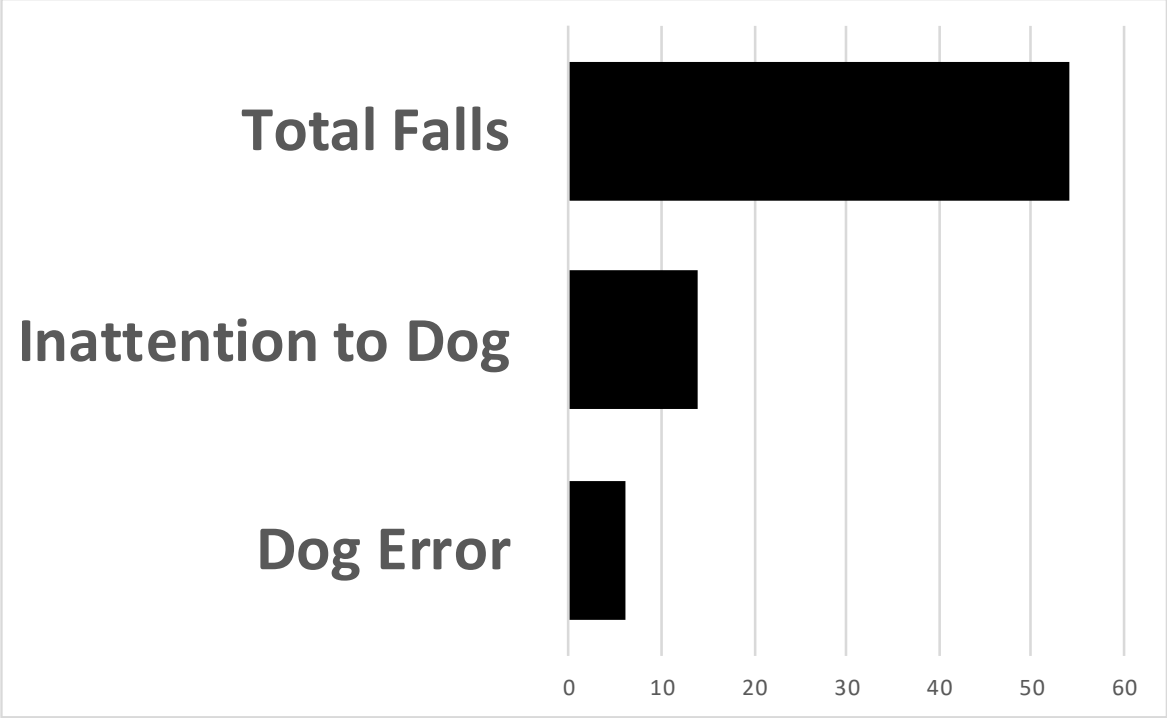
Percentage of respondents reporting frequent falling episodes before and after acquiring a dog guide. * = $p<0.01$, n= 80 respondents.



Of the falls that occurred while using a dog guide, a small percentage of falls were attributed to dog guide error, 8% (n=6). Most falls were reportedly due to inattentiveness of the dog guide user to cues from the dog, 18% (n=13)(Figure 2).

Figure 2.

Number of falls while using a dog guide that were attributable to the individual's inattentiveness to dog guide's direction or to errors in guiding made by the dog guide (as reported by the individual using the dog guide). n= 73 respondents.



The reported severity of injuries due to falls when using dog guides decreased, with a significant reduction in fractures resulting from falls (Figure 3). As with users of a long-cane, the majority of injuries were to the head and extremities, particularly the feet

and legs. There was a significant reduction in the reported number of injuries to the arms and hands following dog guide use (Figure 4).

Figure 3.

Number of respondents reporting the severity of injury from falls: contusions and abrasions, or bone fractures, before and after use of a dog guide.

* = $p<0.05$, n=80.

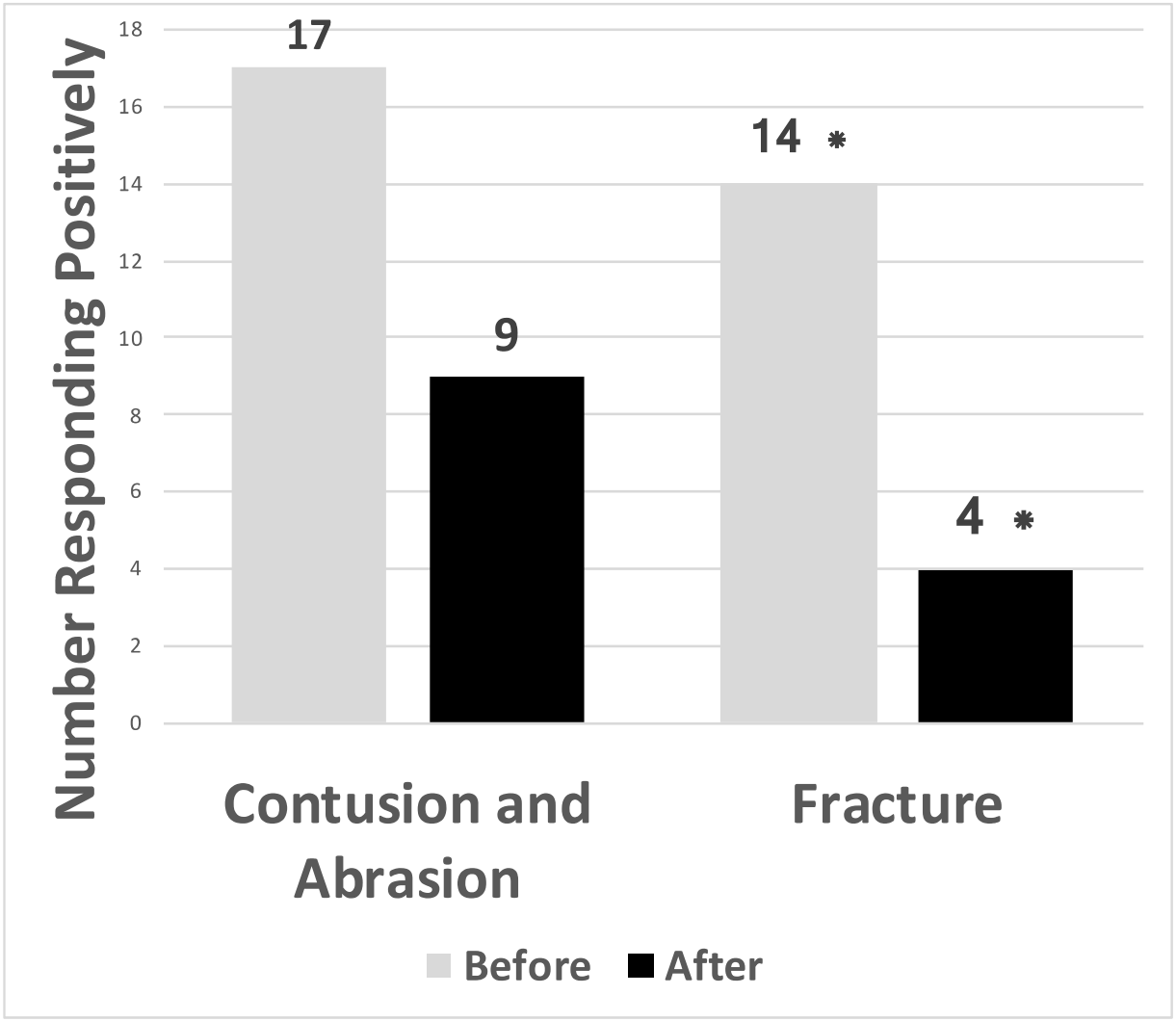
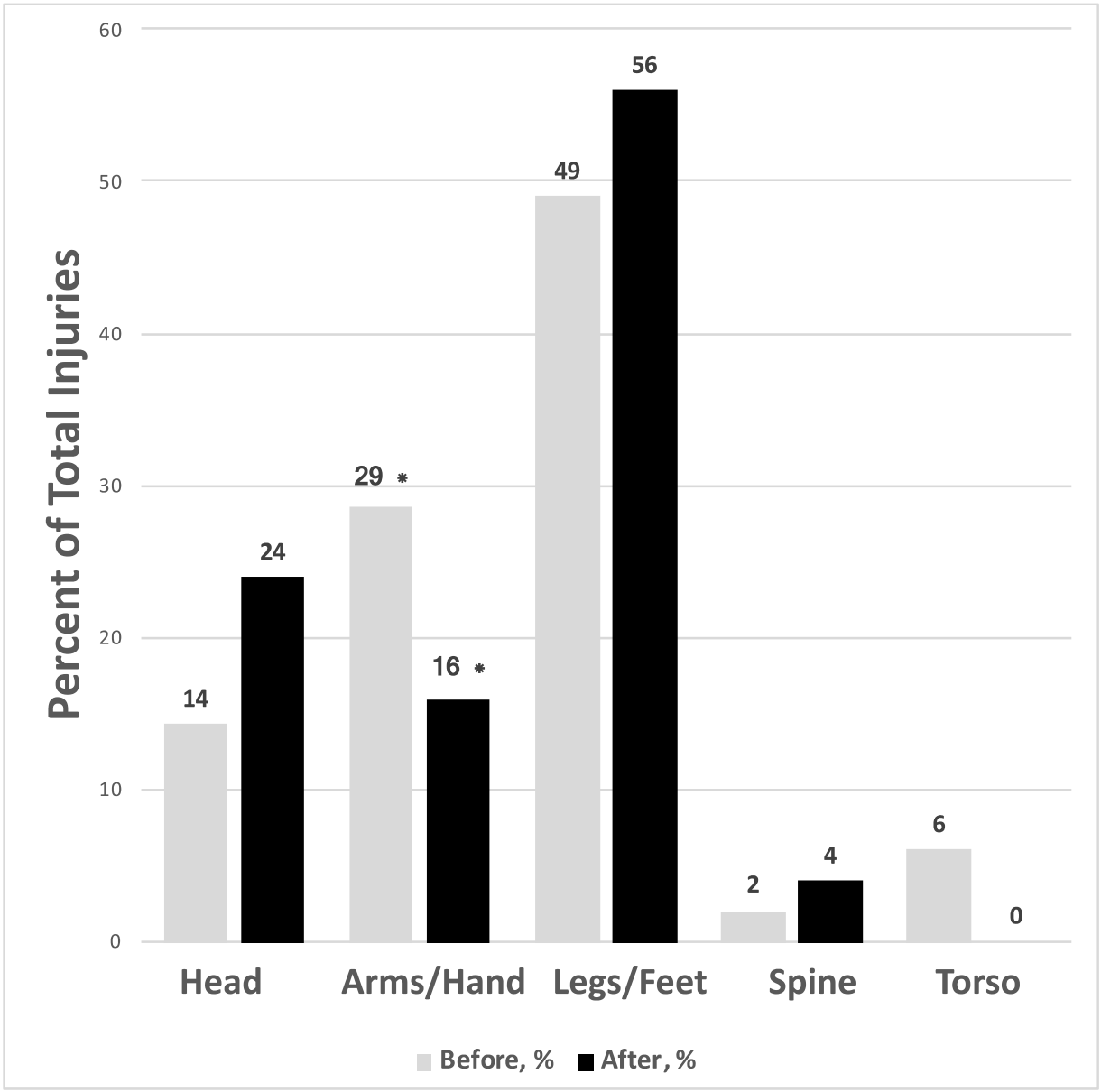


Figure 4.

Percentage of respondents reporting injuries to specific areas of the body due to falling, before and after using a dog guide. * = $p<0.05$, n= 80 respondents.



Users of dog guides reported no change in perceived independence or confidence of mobility ($p < 0.79$, n=80) after receiving a dog guide (Figure 5).

Figure 5.

Confidence that respondents reported feeling about their perceived safety during mobility either before the period of using a dog guide, or after $p>0.05$, n=76.

Complaints of joint pain increased following dog guide use compared to the same population before using a dog guide ($p<0.05$, n=80) (Figure 6).

Figure 6.

Percentage of respondents reporting joint pain before and after acquiring a dog guide. * = $p<0.05$, n= 80 respondents.

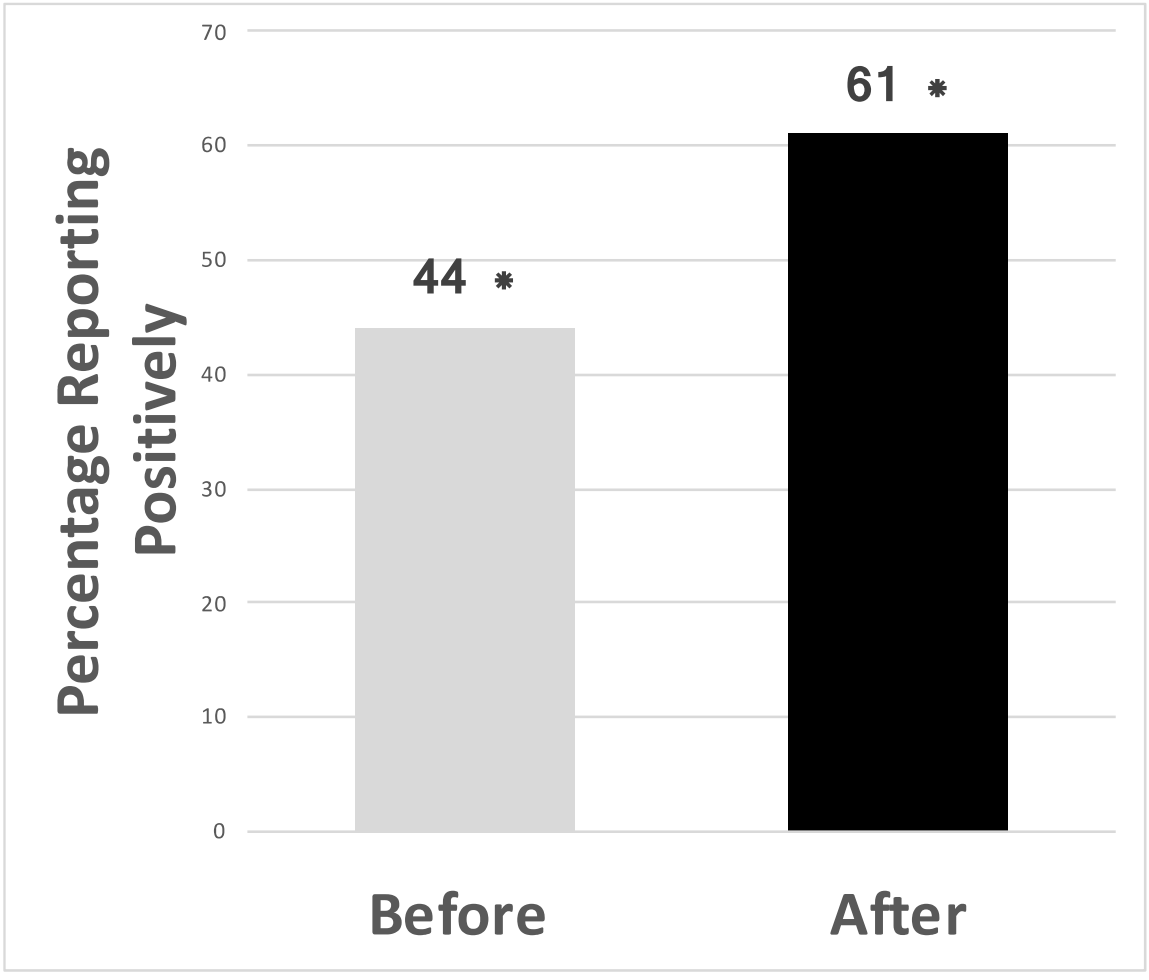
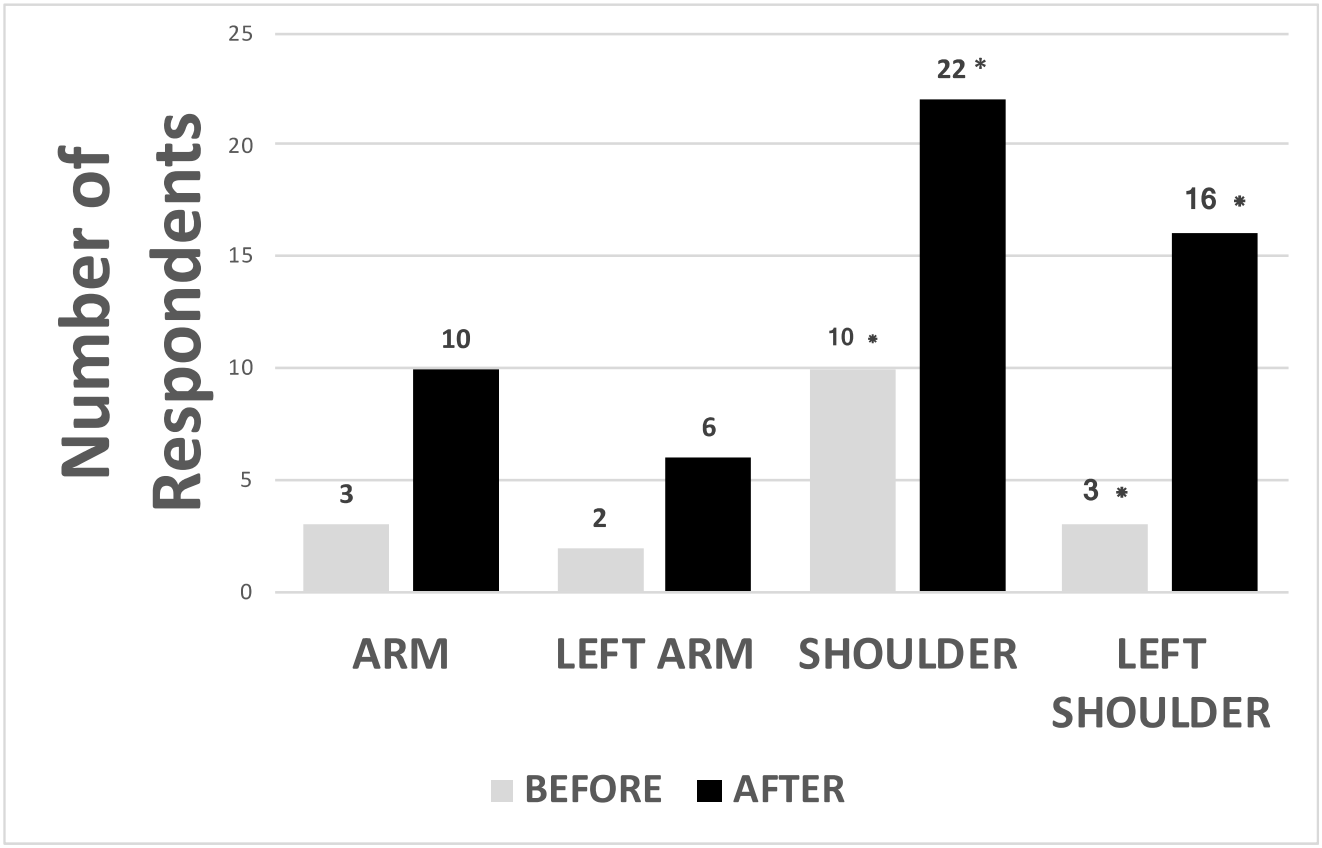


Figure 7.

Pain reported in arm or shoulder by respondents, before and after acquiring a dog guide. Respondents reporting joint pain were asked to indicate location of pain as a free response. Arm data represents response as "arm" plus a summation of responses listing "wrist" or "elbow. Since respondents were asked to report location of pain by free response, we assume that some non-specific reports may potentially be left arm or left shoulder, resulting in potential under-reporting of the observation.

* =p<0.05, n=48 (BEFORE) and n=59 (AFTER). Note that statistics were performed on data normalized for differences in group size.



Analysis of the location of joint pain indicated that there was a statistically significant increase in shoulder pain ($p<0.05$), specifically in the left shoulder ($p<0.05$) (Figure 7). Of the respondents (n=80), 79.2% reported never missing work or school, or having their daily activities affected, due to injuries or pain. Ninety-six-percent reported holding the dog harness in their left hand (Table 1).

Table 1.

Dominant handedness, and the hand in which the dog guide is handled for survey respondents.

Dominant Hand	Dog Guide Harness Held in LEFT Hand	Dog Guide Harness Held in RIGHT Hand
LEFT	14.3% (n=11)	1.3% (n=1)
RIGHT	81.8% (n=63)	2.6% (n=2)
	96.1% (n=74)	**3.9% (n=3)**

Conclusions

Obvious risks related to mobility in persons with visual impairment are falls, and acute injuries resulting from those falls. The majority of these falls resulted in injuries to the extremities and the head. In the present study, respondents who used dog guides reported a significant reduction in the number of frequent falling episodes, injuries to

the hands and arms due to falls, and the severity of acute injuries from falls reflected by a decrease in the number of broken bones resulting from falls.

We report that dog guide use improves the safety of persons with visual impairment when compared to the use of alternative mobility aids. This increased safety seems important to the overall quality of life of dog guide users, by reducing morbidity and improving the ability of the individual to participate in life activities more easily than without using a dog guide.

We did detect that dog guide users in our study reported an increase in chronic shoulder pain following use of a dog guide, specifically in the left shoulder. The overwhelming majority of dog guide users in our study handled their dog and harness with their left arm. Because the physical connection between dog guide and human user involves a mechanical link between the harness handle and the human arm, there is almost constant force applied to the user's shoulder, through acceleration and deceleration in dog and human movements.

Our findings suggest that dog guide use as a mobility aid for individuals with visual impairment may offer both benefits and liabilities for the human user. A decrease in acute injuries due to a reduction in falls may be traded for potential chronic shoulder pain. The mechanism of this shoulder pain is unclear, but may be related to micro injuries in the joint caused by repetitive forces of the human/dog interface, or a sequela of long term changes in posture and gait due to walking while holding the harness. We are pursuing further studies to investigate this phenomenon.

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