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Relationship of depression and medications on incidence of falls among people with late effects of polio

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ABSTRACT

The purpose of this study was to determine if falls in polio survivors, with or without post-polio syndrome (PPS), are related to number of medications taken, use of anti-depressant or psychoactive medications, or self-report of depression. A survey was sent to 300 members of a regional polio support group, asking them to document their fall history, medications used, and the presence of depression. Depression was measured by self-report and with the Geriatric Depression Scale, short form (GDS-15). One hundred and seventy-two usable surveys were returned with 146 of those completing the medication list. Sixty-two percent reported at least one fall in the past year. The multiple logistic regression was significant ($p = 0.023$), and it indicated depression to be a significant predictor ($p = 0.012$) of falls in polio survivors with and without PPS. The number of total medications or anti-depressant or psychoactive medications used was not related to fall incidence. Routine screening and treatment for depression may be one aspect of fall prevention which can be implemented through primary care.

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KEYWORDS

Depression; falls; late effects of polio; post-poliomyelitis syndrome

Introduction

The poliomyelitis virus was nearly eradicated in the United States (US) with the arrival of the Salk vaccine in the 1950s and the Sabin vaccine in the 1960s. Nonetheless, there are an estimated 700,000 polio survivors currently living in the US. Of these survivors, approximately 25% to 40% are affected by post-polio syndrome (PPS) (Centers for Disease Control, 2014; Halstead, 2011). Symptoms of PPS typically occur 25 to 40 years after infection of the poliomyelitis virus and include progressive muscle weakness, fatigue, muscle pain, joint pain, muscle atrophy, and respiratory difficulty (Halstead, 2011). Although the etiology of PPS is unknown, most electrodiagnostic examinations indicate ongoing denervation. This may be due to the effects of aging with increased metabolic demand on the enlarged motor units, overuse causing nerve cell attrition faster than reinnervation can ensue, and immunological and inflammatory occurrences (Bickerstaffe et al, 2014; Borg, 1996; Gonzalez, Olsson, and Borg, 2010; Grimby, Stalberg, Sandberg, and Sunnerhagen, 1998; Halstead, 2011).

The neurologic effects from the original polio illness and the later symptoms of PPS, such as increased muscle weakness, fatigue, reduced balance, and walking limitations, contribute to an increased number of risk

factors for falls in polio survivors (Bickerstaffe, Beelen, and Nollet, 2010; Brogårdh and Lexell, 2014; Génét et al, 2009; Hurmuzlu, Basdogan, and Stoianovici, 1996; Legters et al, 2006; Lord, Allen, Williams, and Gandevia, 2002; Silver and Aiello, 2002), thus leading to an increased incidence of falls. The risk factors for falls in older adults, in general, include the following: the use of four or more medications; balance or gait instability; postural hypotension; vision impairment; and home hazards (Bradley, 2011; Weber, White, and McIlvried, 2008; Zeimer, 2008).

According to Bickerstaffe, Beelen, and Nollet (2010), the rate of polio survivors who fell in the past year was four times that of other adults over the age of 55, with 74% reporting at least one fall. Other investigators have reported that 50% to 84% of individuals with PPS admit to falling in the past year (Brogårdh and Lexell, 2014; Hill and Stinson, 2004; Legters et al, 2006; Silver and Aiello, 2002) with 63% to 95% reporting a fear of falling when explicitly asked (Bickerstaffe, Beelen, and Nollet, 2010; Legters et al, 2006).

Depression and anti-depressant and psychoactive medication use are strongly associated with falls in community-dwelling older adults (Kerse et al, 2008). Sixteen to 40% of older adults with history of polio or PPS have shown depressive symptoms on various

depression outcome measures (Berlly, Strauser, and Hall, 1991; Clark, Dinsmore, Grafman, and Dalakas, 1994; Hazendonk and Crowe, 2000; Jensen et al, 2011; Kemp, Adams, and Campbell, 1997; Kemp and Krause, 1999; Pierini and Stuijbergen, 2010; Tate et al, 1994). Some studies have found people with PPS to have a higher incidence of depression than polio survivors without PPS (Hazendonk and Crowe, 2000; Kemp, Adams and Campbell, 1997), whereas others have found depression not significantly different than age-matched controls (Clark, Dinsmore, Grafman, and Dalakas, 1994; Kemp and Krause, 1999), and at least one study found a much lower rate of moderate-to-severe depression (7.3%) than in the general population of older adults (Zelman and Olkin, 2007).

The Geriatric Depression Scale (GDS) is a common measure for depression and has been standardized for community-dwelling elders and neurologic populations, including those who are survivors of polio and people with PPS (Burke, Roccaforte, and Wengel, 1991, D'Ath et al, 1994; Kemp, Adams, and Campbell, 1997; Kemp and Krause, 1999). The short form of the GDS, or GDS-15, has 15, rather than 30 items, and has been found to have similar reliability, validity, sensitivity, and specificity to the original measure in older adults who are cognitively intact (Burke, Roccaforte, and Wengel, 1991, D'Ath et al, 1994; Hermann et al, 1996).

Previous fall-related studies have focused on self-reported impairments, walking limitations, fear of falling, balance confidence, quality of life, osteoporosis, and fractures in individuals with PPS (Bickerstaffe, Beelen, and Nollet, 2010; Brogårdh and Lexell, 2014; Hill and Stinson, 2004; Legters et al, 2006; Mohammad et al, 2009; Pierini and Stuijbergen, 2010; Silver and Aiello, 2002). However, no study has assessed the relationship of depression and medications to the incidence of falls within the polio survivor population. The purposes of this study were to determine if a relationship exists between the incidence of falls and the: 1) number of medications taken; 2) the use of psychoactive or anti-depressant medications; and 3) depression, as documented by self-report or GDS-15, in polio survivors, with or without PPS. The hypothesis of this study was that the incidence of falls will be related to depression (self-reported or GDS-15 score), the number of medications taken, or use of psychoactive or anti-depressant medications in polio survivors.

Methods

The survey was developed with input from members of the International Polio Clinics Directors' Network. It included questions on demographics, general health,

medication use, use of mobility devices, home and work environment, falling history, balance confidence, and depression. Surveys were mailed to members of the Texas Polio Survivors' Association (TPSA), and all participants remained anonymous with no personal identifiable information collected. The Institutional Review Board of Texas Woman's University approved this study.

Depression was measured with the GDS-15 and was self-reported through this question, "What health problems, other than polio, do you currently have and take medicine for or are under the supervision or treatment by a doctor? (Check all that apply.)" Depression was one of the health conditions listed that the participant could check yes/no. Questions related to falls included "Have you fallen (an unplanned trip to the floor) in the past 12 months?" Additional questions addressed fall frequency and circumstances of the fall. Medications were reviewed and categorized based on the number of total medications, depression medications, and other psychoactive medications taken. Self-report of depression, GDS-15 score, and fall question responses remained as separate dependent variables. A score ≥ 5 on the GDS-15 was used to indicate depression (Hermann et al, 1996), and four or more medications taken were used as the cutoff value for risk for falling, based on existing literature of community-dwelling older adults (Bradley, 2011; Weber, White, and McIlvried, 2008). A multiple logistic regression was conducted to predict if falls were determined by the number of medications taken, depression and/or psychoactive medication taken, polypharmacy (yes/no ≥ 4 medications), and reported depression as measured by the GDS-15 (score ≥ 5). Multi-collinearity of the independent variables was assessed using cross-tabulations and the phi coefficient. Results indicated that taking depression and/or psychoactive medication and polypharmacy were significantly related ($p < 0.001$, $\phi = 0.347$). Since the phi coefficient indicated only a moderate relationship between the two variables, both were left in the model. All variables were entered into the model simultaneously. Statistical analyses were completed in SPSS 19.0.

Results

Of the 300 surveys mailed by TPSA, 172 (57%) usable surveys were returned. All 172 included a completed GDS-15, and 146 (84%) surveys were completed with a list of current medications. Average age was 67 years, 69% were female, and 92% reported PPS. See Table 1 for demographic data of the participants from usable surveys.

Table 1. Participant demographic information.

	Sample of usable surveys (N = 172)
Age (years), mean ± SD (range)	66.6 ± 10.1 (37–91)
Age at polio onset (years), mean ± SD (range)	7.0 ± 7.3 (0.1–55)
Reports PPS (yes/no)	158/14
Gender (M/F)	54/118
Race	
Asian/Pacific Islander/Aleutian	3
Black/African American	3
Hispanic/Latino	8
White	155
Other	3

Sixty-two percent of participants reported falling in the past 12 months (106 of the total sample of 172). Similarly, of the respondents who provided a medication list, 91 (62%) reported at least one fall. The mean number of medications taken by people who had fallen (91 of 146) in the past 12 months was 5.0 (SD 3.8) and by people who had not fallen (55 of 146) was 5.1 (SD 3.6). See Table 2 for medication use for people who had fallen and not fallen in the previous 12 months. There were no significant differences between the fallers and non-fallers on the number of prescribed medications ($p = 0.877$). However, there was a significant difference for the raw GDS-15 scores ($p = 0.001$); fallers had significantly higher GDS-15 scores than non-fallers.

Of the 146 individuals who reported their medications, 42 (29%) reported use of depression and/or psychoactive medications, and 52 (36%) participants reported taking ≥ 4 medications. Of all the participants, 44 (25%) had a self-report of depression, and 71 (41%) scored in the depression range on the GDS-15. Sixty-six (45%) of the 146 people who reported medications in the survey indicated depression, either by self-report or GDS-15 scores. Twenty-eight (19%) of these and 42% of those presenting with depression, respectively, were taking anti-depressants, and 58 (34%) reported falling in the last year. When examining people taking anti-depressant medication and reporting depression, 28/38 (74%) of those taking medication continued to report depression as a health condition and/or scored a five or greater on the GDS-15, and 28/66 (42%) of those

Table 2. Fallers versus non-fallers, depression, use of medications.

	Total sample	Fallers	Non-fallers
Depression	172	106	66
Self-report	44	33	11
GDS-15 (mean ± SD)	4.6 ± 3.5	5.2 ± 3.7	3.5 ± 2.9
GDS-15 score ≥5	80	58	22
Medications	146/172	91/146	55/146
Total # medications used (mean ± SD)	5.1 ± 3.8	5.0 ± 3.8	5.1 ± 3.6
# with polypharmacy (4 or more medications)	89	52	37
# taking psychoactive or anti-depressant medications	42 psychoactive 38 anti-depressant 18 both	29 psychoactive 27 anti-depressant 14 both	13 psychoactive 11 anti-depressant 4 both

Table 3. Relationship of medication use and depression.

	Taking anti-depressants		
	Yes	No	Total
Self-report of depression or scored for depression on GDS-15	Yes 28	No 38	66
	No 10	70	80
Total	38	108	146

Table 4. Summary of logistic regression model.

	β	Odds Ratio	95% CI		p
			Lower	Upper	
Total number of medications	0.035	1.035	0.89	1.20	0.647
Taking anti-depressant and/or psychoactive medication	0.454	1.575	0.71	3.49	0.262
Polypharmacy	−0.974	0.378	0.13	1.11	0.077
Depression (GDS-15)	0.965	2.623	1.23	5.58	0.012

reporting depression were taking anti-depressant medication. See Table 3 that describes people reporting depression and use of anti-depressant medication.

Overall, the multiple logistic regression was significant: $\chi^2(4) = 11.38$, $p = 0.023$, Nagelkerke $R^2 = 0.102$. Of all the predicted variables, only whether or not participants were depressed was significant ($p = 0.012$) with an odds ratio of 2.623 (95% confidence interval = 1.23 to 5.58), indicating that participants who were depressed were more likely to have fallen in the previous 12 months. See Table 4 for results of the logistic regression.

Discussion

The results of this study confirm that there is a high level of falling among older persons with polio or PPS (62%), and this incidence is consistent with that reported in previous studies (Bickerstaffe, Beelen, and Nollet, 2010; Brogardh and Lexell, 2014; Hill and Stinson, 2003; Legters et al, 2006). Depression significantly predicted fall occurrence in this sample, and this part of the hypothesis was accepted. Participants' self-report of depression and GDS-15 score were generally

in agreement in our sample. A high prevalence of depression was present in this sample (25% to 41%), as compared to 7.7% reported in adults ages 50 and older (Centers for Disease Control, 2015).

Furthermore, those who self-identified as being depressed and/or scored as depressed on the GDS-15, were often being treated with anti-depressants. However, our study's sample indicated that 42% of participants reported depression, either when asked the question or by GDS-15 score, while taking anti-depressant medication. Although medication compliance and neurobehavioral interventions were not measured in this study, anti-depressant medication use of these participants did not appear to reduce depression (enough for scores of GDS-15 to be 4 or lower) for a sizable group, as is consistent with other literature on treatment of depression (DeRubeis, Siegle, and Hollon, 2008; Dimidjian et al, 2006).

Although depression is noted to be related to falls in older people (Kerse et al, 2008), causality between incidence of depression and falls was not established, although depression was a significant predictor of falls in this study. Certainly other known risk factors for, or issues that co-exist with falling, such as LE weakness, musculoskeletal deformities, walking, and balance difficulties, were likely present in at least some of the respondents. However, these physical impairments and functional limitations were not examined and may be considered a study limitation.

Assessing and addressing depression in primary care environments could be one method of reducing incidence of falls among older adults with PPS or history of polio. Depression is commonly considered to be a risk factor for falls among community-dwelling older adults (Bradley, 2011; Eggermont, Penninx, Jones, and Leveille, 2012). If anti-depressants are not adequately treating depression for a population that has four times the fall rate of older adults (Bickerstaffe, Beelen, and Nollet, 2010), then maximizing fall incidence reduction may not be occurring sufficiently in the polio survivor community.

Delbaere et al. (2004) described the “vicious cycle of frailty” in which each step of the cycle feeds into the next step, even if an actual fall has not occurred. The cycle includes fear of falling, falls (occurred or not), reduction in feared activities, loss of physical function, decreased postural control, difficulties in activities of daily living, and back to fear of falling. Inadequate fall reduction is problematic in that falls, injuries from falls, and fear of falling can lead to reduced activities and societal participation (Denkinger, Lukas, Nikolaus, and Hauer, 2015), thus increasing the risk of depression (Yang et al, 2015).

Although polypharmacy is a risk factor for falls in community-dwelling older adults, this study found no significant relationship between falls and the number of medications used, taking four or more medications or taking psychoactive medications. The lack of this association is unclear. The risk of falling already might be so high in polio survivors that medications do not appreciably increase that risk.

The strengths of this study included the 57% return rate on surveys, with 100% usable surveys for depression analysis and 146 (84%) of the total 172 usable surveys for medication analysis. Although not previously investigated with the polio survivor community, the GDS-15 used to objectively measure depression is standardized for community-dwelling elders and other neurologic populations. The GDS-15 showed high agreement ($r_s = 0.899$) with self-report of depression in this study, with 92 of the 172 participants denying depression and scoring below a five on the GDS-15, and 35/172 reporting depression and scoring a five or above.

The key limitations of this study included the lack of diversity both geographically and in ethnicity. Furthermore, since surveys were sent to the membership of a polio support group, the participants may have been seeking support and have been biased towards having more incidence of depression than polio survivors, in general.

Conclusions

Our results indicate that depression is related to incidence of falls in polio survivors. Unlike older adults without a history of polio, polypharmacy (≥ 4 medications) and the use of psychoactive medications do not increase the risk for falls among the polio survivor population. Depression appears to be accurately identified and treated through medication among polio survivors, although under treatment of depression may be occurring. We urge more screening for depression in primary care settings to help reduce fall incidence in this population.

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Association (APTA) Combined Sections Meeting (CSM), Indianapolis, IN. Survey analyses and results from other parts of the pilot questionnaire were presented in poster format by Kelley CP, Housinger E (2013—Relationship of mobility, balance confidence, and depression with falls among survivors of polio) at APTA CSM, San Diego, CA. B Zuckerman was a student physical therapist at Texas Woman's University during the time of this study, working on this project for partial degree fulfillment of her degree requirements.

Declaration of interest

The authors report no declarations of interest.

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