FALL RISK BEHAVIORS AND INTRINSIC RISK FACTORS FOR FALLS IN INDIGENOUS AND NON- INDIGENOUS RURAL OLDER ADULTS

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ABSTRACT

FALL RISK BEHAVIORS AND INTRINSIC RISK FACTORS FOR FALLS IN INDIGENOUS AND NON-INDIGENOUS OLDER ADULTS

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The purpose of this study was to examine fall risk behaviors and intrinsic risk factors for falls in rural dwelling indigenous and non-indigenous older adults in California. Methods: Participants included 157 adults 60+ years of age (89 indigenous and 68 non- indigenous) and were recruited from advertisements in local newspapers, senior centers, and health clinics in Humboldt and Del Norte Counties. Fall risk behaviors and intrinsic risk factors for falls were identified through administration of a demographic, fall risk, and physical activity questionnaire as well as the chair stand, functional reach, timed up and go, four-meter walk, and modified clinical test of sensory integration and balance. Results: Analyses indicated indigenous and non-indigenous older adults differed in age, percentage who fell two or more times in the past year, number of medications taken, percentage that exercise daily, and hours of daily exercise. Analyses indicated indigenous older adults performed worse on tests of intrinsic fall risk including the chair stand, timed up and go, functional reach, and condition 1 of the M-CTSIB test (eyes open, firm surface). Conclusion: Although indigenous and non-indigenous older adults share similar fall rates, there were a greater number of indigenous older adults who fell multiple times a year. Strength, balance, and mobility were also

significantly more impaired in indigenous older adults. Information gained from this study can help to inform clinicians and researchers about the prevalence of falls and factors contributing to falls among older indigenous Americans living in rural communities, and help to influence decisions in the future of programs for reducing fall risk in this often neglected population.

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INTRODUCTION

By 2030, 20% of the U.S. population will be over the age of 65 (1). Individuals 85 years and older are the fastest-growing group of older adults, growing at a rate that is three times greater than the 65 to 85 age group (1). As the number of older adults increase, an increase in the number of falls sustained by older adults is also expected. Currently, one in three community-dwelling older adults age 65 years and older suffers a fall each year with 50% of them falling multiple times per year (2). On average, older adults living in a community setting sustain 0.2 to 1.6 falls per year (1).

In older populations, falls are the leading cause of injuries, hospitalizations, and fatalities in the U.S (3). In 2010, direct medical costs for injuries associated with falls totaled $31 billion annually and are estimated to reach $54.9 billion by 2020 (4). These falls are costly, both in relation to acute care and long-term disability and fall risk. As people age, falls and deaths related to falls increase dramatically, especially in people over the age of 70 years (1). These increased rates of falls, coupled with increased prevalence of clinical diseases and physiological normal declines associated with aging, make mild falls extremely risky. Factors directly affecting fall risk include physiological changes due to age, impaired cognition, medication use, environmental hazards, and chronic health conditions such as diabetes (1-3, 5, 6).

While considerable attention has been placed on the risk and effects of falls among urban and predominantly Caucasian older adults, little is known about fall risk and factors affecting fall risk among indigenous Americans. According to the United

States Commission on Civil Rights, “After termination, removal, and assimilation by the U.S. indigenous people were substantially worse off than white American society” (7). Traditionally, indigenous Americans participated in a variety of physical activities that supported a healthy lifestyle including hunting for food, dancing and playing traditional games. In fact, many indigenous natives see traditional games as a strong indicator that their culture can survive (8). However, over the past century, these traditional physical activities appear to occur less often (8, 9). In addition to potential decreases in physical activity, Indigenous people have less access to health care than non-indigenous people (7). Because of these barriers, significantly lower health status and higher rates of disease are present in indigenous populations across the United States (7, 10, 11).

California has one of the largest populations of indigenous people living in rural areas where population density is fewer than 950 people per square mile (10). Within California, older adults living in rural counties have higher rates of falls than urban older adults (1). All of rural California, and particularly the Redwood Coast Region (Del Norte, Humboldt, Mendocino and Trinity counties), has an increasing population of older residents who are at an increased risk of preventable falls. The Redwood Coast Region has recorded a higher percentage of falls among seniors than California as a whole (10, 12).

Although many indigenous people live in rural areas, it is unclear whether this increased rate of falls among indigenous elders is related to living in rural communities. Indigenous older adults fall more than the average (34-40.3% vs. 30%), suggesting that factors known to contribute to falling may also be more prevalent among indigenous

older adults (11). Although there is a myriad of factors that have shown to contribute to falling, physiological declines associated with normal aging such as our balance and mobility have been shown to play the greatest role on our fall risk.

Factors Contributing to Falls

Physiological declines associated with normal aging have the greatest impact on fall risk. These variables include decreased proprioception, vision, strength, and flexibility, all of which contribute physiologically to balance and mobility (1-3, 6). Proprioception is the sense of the body's position in space; it is essential for balance, posture, and movement and becomes less accurate with age (13). Proprioception, especially in the feet, can be further impaired by diseases such as diabetes or peripheral neuropathy (14, 15). Not only does proprioception become less accurate but also visual acuity declines as well (1, 3, 6). This reduction in accuracy of senses can lead to less confidence in one's mobility as well as higher rates of sedentary behavior. Older adults with more sedentary behavior tend to have less strength, flexibility, and general mobility. As people age, muscle strength on average decreases by 30% between the ages of 50 and 70; deterioration accelerates over the age of 80 (16). Decreases in flexibility have been associated with an increased cost of walking and thus decreased mobility (2, 4, 17). Older populations also develop changes in the way they walk and experience more falls when walking (18, 19). Older adults generally walk at a slower preferred pace, take shorter steps, and tend to be less efficient walkers (1, 3, 6, 18, 20). All of these physiological changes directly influence balance and mobility, thus the most important

variables to improve to, have the greatest effect of reducing falls (1-6). Exercise has been shown to be the most effective intervention to improve balance and mobility and thus, the most effective single intervention at reducing fall risk (3, 6).

Balance, mobility, and muscular strength are among the most important factors to decrease fall risk (3, 6). Balance is a common term that consists of static and dynamic postural stability. Static postural stability is the ability for individuals to maintain their center of gravity within their base of support without movement, whereas dynamic postural stability is the ability for individuals to maintain their center of gravity within their base of support while performing specific movements (21). Mobility is defined as the ability of individuals to purposely move about their environment. Older adults with mobility limitations have been shown to have decreased health, increased risk of disability, and increased fall risk (22). Muscular strength is defined as the ability of a muscle group to develop maximal contractile force against a resistance in a single contraction.

Indigenous populations have higher rates of disease and greater than average fall risk, thus possibly suffering greater physiological declines associated with age than urban or other rural older adults (4, 23). Falls are the number one reason for a hospital stay among indigenous older adults (11). Although fall risk behaviors and intrinsic risk factors for falls have been studied extensively in urban populations and more specific ethnic and racial groups of older adults such as Caucasian, Latino and even Asians, little is known about fall risk and its relation to balance and mobility in older Native Americans living in rural areas. To our knowledge, no study has ever compared fall risk behaviors and

intrinsic risk factors for falls in indigenous and non-indigenous elders living in rural communities. Thus, the purpose of this study is to examine fall risk behaviors and intrinsic risk factors for falls in rural dwelling indigenous and non-indigenous older adults in California.

METHODS

Subjects

Participants included 157 older adults who were recruited from advertisements in local newspapers, senior centers, and health clinics. A telephone interview was used to prescreen if subject candidates met the inclusion criteria. In order to participate in the study, participants needed to be over the age of 60 and live in Humboldt and Del Norte County. Subjects were classified as indigenous community dwelling (n = 89) or non-indigenous community dwelling (n = 68). All indigenous community dwelling participants self-identified as being group Native American and living within a rural indigenous community with a population density of fewer than 950 people per square mile.

Procedure

Upon completion of the prescreening questionnaire participants were assigned a date and appointment time for testing at a predetermined location. Upon arrival to testing facility, participants provided informed consent and completed the Demographic and Fall Risk and Physical Activity Questionnaires (Appendix) prior to participation. The Demographic and Fall Risk and Physical Activity Questionnaires provided self-reported information on age, sex, living location, fall history, history of imbalance, prescription medications used, physical activity behaviors, and exercise behaviors. Physical activity was defined for participants as “the amount of time you aren’t sitting or sleeping per day”

and exercise was defined as structured, planned, and purposeful activity that participants have been consistently engaging in for two or more months. Subjects then completed five tests to quantify intrinsic risk factors for falls. Participants that didn't feel comfortable or unable to complete a test, had their score removed for that particular test.

22 research assistants participated in this study. To ensure reliability and consistency among researchers, all were trained in evaluation procedures by the principal investigator. For each test, one assistant was assigned to administer the test as well as one assistant to spot for safety. Participants completed the tests in no particular order as the tests are not exhaustive in nature and do not require specific testing order. Nonetheless, participants were given as much time as needed to rest after each test and moved on to the next test when they felt comfortable.

Measures

These tests included the Chair Stand Test, Timed Up and Go (TUG), Modified Clinical Test for Sensory Integration and Balance (M-CTSIB), Functional Reach Test, and the 4-meter walk. The Chair Stand Test was used to assess lower body strength (24). In a seated position, participants were asked to stand up and sit down as many times as they could during one 30 second-time trial. Number of successful chair stands was recorded. The M-CTSIB and TUG are used to assess postural stability (dynamic and static balance)(5, 21, 25) .The M-CTSIB test requires participants to balance on a force sensing platform with four different types of sensory feedback (eyes open and eyes closed, standing on foam pad, standing on firm surface). Participants completed one 30

second trial of each of the four conditions. The average sway velocity in mm/s was recorded per condition. The TUG is a test for dynamic balance that measures the time it takes participants to stand up from a chair, walk a distance of three meters, turn around a cone, walk back to the chair, and return to the seated position. Participants completed two trials of the TUG, the best score (fastest time) was used out of the two.

Mobility and general frailty was assessed through Functional Reach Test and 4-meter walk test (26, 27). The Functional Reach test required participants to stand with both feet on the ground and reach as far forward as you they can. Participants were asked to complete three trials and were measured on how far they could reach. The average of the three trials was used as the participants average score. The 4-meter walk test is used to assess average walking speed, which has been shown to predict frailty and fall risk (3, 5, 6). In this test, participants were timed on preferred walking speed over a straight 4 meter course. Participants completed two trials of the 4-meter walk test. Their best time of the two trials was used.

STATISTICAL ANALYSIS

All statistical analyses were conducted using the statistical package SPSS for Windows 7 (version 25.0; Chicago, IL, USA). There were no outliers found and no transformations were needed. T-tests and cross tabulation chi-square tests were used to determine variables that differed significantly between indigenous and non-indigenous older adults ($p<.05$). When appropriate, the Mann-Whitney U test was used for variables that violated normality.

RESULTS

Fall Risk Behaviors

Analyses indicated indigenous and non-indigenous older adults differed on age, subjects fallen two or more times in the past year, number of medications, percent who exercise regularly, and hours of regular exercise (Table 1). When looking at the characteristics, indigenous older adults were younger (M = 71.17, SD = 8.29) than non-indigenous older adults (M = 74.13, SD = 7.186) in the sample. This difference was significant $t(155) = 2.34$, $p<.05$; it did represent a small effect r = .184. Interestingly, the percent of individuals who had fallen two or more times in the year prior to the study was higher in indigenous older adults than in non-indigenous older adults by almost 10% $\chi^2 (1) = 3.846$, $p< .05$). In terms of medication use, indigenous older adults (M = 4.17 prescriptions, SD = 3.64) used 1.32 more prescription medications than non-indigenous older adults (M = 2.85 prescriptions, SD = 2.99). This difference was significant $t(145) = -2.375$, $p<.05$); it did represent a small effect r = .1935. Indigenous older adults exercised more than 50% less often than non-indigenous older adults $\chi^2 (1) = 18.381$, $p<.05$. Indigenous older adults (M = .96 hrs, SD = .58) exercised for less time than non-indigenous older adults (M = 1.37 hrs., SD = .71). The difference was significant $t(64) = 2.397$, $p<.05$); it did represent a small sized effect r = .287.

Intrinsic Risk Factors for Falls

Analyses indicated indigenous and non-indigenous older adults differed on four of eight intrinsic risk factors for falls identified for this study (Table 2). In the Chair Stand Test, which is a test for lower leg strength, non-indigenous older adults (M = 13.59, SE = .55) had a 31.12% greater score than indigenous older adults (M = 9.36, SE = .42). This difference was significant $t(149) = 6.191$, $p<.05$; it represents a medium-sized effect r = .452. In the Functional Reach Test, which is a test for dynamic balance as well as general mobility, non-indigenous older adults (M = 13.84, SE = .43) had a 17.55% greater score than indigenous older adults (M = 11.41, SD = .36). This difference was significant $t(153) = 4.324$, $p<.05$; it represents a medium-sized effect r = .329. In the TUG test, which is a test for dynamic balance and functional mobility (28), indigenous older adults (M = 11.35, SE = .61) had a 27.22% greater TUG score than non-indigenous older adults (M = 8.26, SE = .35). This difference is significant $t(132.189) = -4.34$, $p<.05$; it represents a medium-sized effect r = .353. In the M-CTSIB test, which is a test for sensory integration and balance, there was no difference in all conditions except for condition 1 (firm surface, eyes open) where indigenous older adults (M = 2.90, SE = .13) had a 25.17% greater score than non-indigenous older adults (M = 2.17, SE = .12). This difference is significant $t(145) = -3.778$, $p<.05$; it represents a medium-sized effect r = .3.

DISCUSSION

The purpose of this study was to examine fall risk behaviors and intrinsic fall risk factors in indigenous and non-indigenous older adults living in rural California. Our results showed that fall risk behaviors and intrinsic fall risk factors were significantly different between indigenous and non-indigenous rural dwelling older adults. The findings suggest that although indigenous and non-indigenous older adults share similar fall rates, there are a much greater number of indigenous older adults falling multiple times a year. Interestingly, there were not higher rates of fear in those who had fallen multiple times a year, which was not consistent with past research (29).

The use of medications is closely tied to an increased risk of fall among older adults. The number of prescribed medications was higher in indigenous than non-indigenous older adults. The increased use of medication may be related to an overall lower health status and increased rates of disease often observed in indigenous rural populations across the nation (7, 10, 11). However, it is difficult to ascertain the individualized relationship between falls and disability; i.e., falls lead to disability or disabilities leads to fall. Nonetheless, limitations in access to health care and support services for older indigenous adults living in rural areas (2, 10, 11) may contribute the greater prevalence of health issues and medication use; and thus an increased risk of fall.

Another key factor known to influence fall risk is participation in exercise and physical activity. Regular participation in exercise has been shown to improve strength, balance, mobility, independence, and general quality of life (30). In the present study,

indigenous older adults reported exercising less often and those that did exercise regularly, exercised close to a half hour less than non- indigenous older adults. This difference in exercise participation may help to explain why indigenous older adults demonstrated impaired balance, mobility and lower body strength in the M-CTSIB test, timed up and go, 4m walk test, and chair stand test, respectively. Multi-factorial fall risk programs aimed at increasing balance, mobility, and strength have been shown to have the greatest effect on reducing the prevalence of falls in those who have fallen multiple times in a year (6, 31, 32). Coincidentally, these programs were also developed to be easily disseminated to the public and be very cost effective (3). The implementation of such low cost and accessible exercise programs may be an effective strategy for improving health and reducing fall risk among indigenous older adults living in rural communities.

Factors that were not different between the two groups included gender, fallen past year, fearful of falling and physical activity hours. Although differences in gender and fear of falling is consistent with past research, we had a much higher amount of reported falls within the past year of indigenous and non-indigenous older adults which was not consistent with past research (11, 33). This could be due to past studies included older adults as young as 45 years old report yearly falls, possibly providing an inaccurate representation of older adults (65+). We also saw no difference in amount of physical activity between indigenous and non-indigenous older adults which was not consistent with past research, showing indigenous older adults experiencing less daily physical activity (7, 10, 11, 33).

Despite results showing significant differences in almost all intrinsic fall risk factors, differences in Functional Reach or conditions 2-4 of the M-CTSIB tests were not observed. This lack of difference may be due to the fact that several individuals were unable to complete these tests due to fear of falling or pain discomfort. Many of these individuals were participants who had fallen multiple times in the past year. A more inclusive test to measure balance such as the ABC – 16 test (28) which has been shown to be sensitive enough for even the most frail to assess balance, may be necessary for future research in this population in order to better assess detriments in balance and avoid a possible floor effect.

When considering the broader practical applications and interpretations of the current data it is important to recognize the limitations of the study. First, participants included volunteers. If subjects were randomly recruited from the community, the results would likely be different. Thus, application of this data to other populations, different age groups, or special populations would not be appropriate. This study also measured balance mobility and fall risk only among indigenous older that live in Humboldt, Del Norte counties of northern California. While the findings of prior research support the finding of this study that indigenous older adults have increased fall risk, is remains unclear whether the same risk factors affect all indigenous peoples. Future studies should investigate fall and fall risk factors in different tribes/locations of indigenous older adults to better understand whether these risk factors differ among tribes. Moreover, it would be beneficial for future studies to assess the effectiveness of fall prevention exercises on fall risk in these communities. While several types of exercises and exercise programs have

been shown to be effective in reducing the risk of falls among urban dwelling older adults, it remains unclear whether these same programs can be implemented effectively in rural communities or among indigenous older adults.

This study has shown that although indigenous and non-indigenous older adults share similar fall rates, there are a greater number of indigenous older adults falling multiple times a year. The cyclical effects of experiencing multiple falls in a year can negatively impact one's physiological, psychological, and one's behaviors throughout the day. We tend to see higher rates of sedentary behavior and poorer strength, balance and mobility in older adults who fall multiple times a year. Accordingly, strength, balance, and mobility were also shown to be significantly impaired among the indigenous older adults when compared to non-indigenous older adults. To our knowledge, no study has looked at intrinsic fall risk factors or fall risk behaviors in indigenous older adults. Information gained from this study will 1) help to inform clinicians and researchers alike about the prevalence of falls and factors contributing to falls among older indigenous Americans living in rural communities; and 2) may help to influence decisions in the future of programs for reducing fall risk in this often neglected population.

Some insights for future research must be noted. There is significant association between falls and the use of sedatives and hypnotics, antidepressants and benzodiazepines. Other drug classes have also been associated with an increased fall risk. Although we found indigenous older adults prescribed a higher number of medications than non-indigenous it is unclear what type of medications were prescribed. It is recommended to ask participants to bring their medication list when coming to their

appointment in order to better understand if certain medications play a role in falling in this population. Another insight to note is that although we found exercise rates to be lower in the indigenous population, it is unclear if this lack of exercise is confounded by lack of facilities and access to exercise equipment in rural indigenous areas. It is important for future researchers to look into access to exercise facilities and equipment and its relation to exercise prevalence in this population.

TABLES

Table 1. Fall Risk Behaviors of indigenous and non-indigenous communities

Characteristic	Indigenous (n=89)	Non-indigenous (n=68)	*P* (test)
Age	71.17 ± 8.29	74.13 ± 7.186	.021 (t test)
Gender (%) female	75.50%	72.05%	.649 (χ^2)
% fallen 1+ times past year	50.00%	54.40%	.632 (χ^2)
% fallen 2+ times past year	38.45%*	29.40%*	.050 (χ^2)
% of falls occurring inside	35.89%▲	9.37%▲	.092 (χ^2)
% of falls occurring outside	25.64%▲	81.87%▲	
Fearful of falling (%)	62.22%	70.58%	.251 (χ^2)
No. of prescribed Medications	4.17 ± 3.64	2.85 ± 2.99	.019 (t test)
Physical Activity per day (hrs)	4.62 ± 3.66	5.62 ± 3.62	.106 (t test)
% that exercise regularly	30%	64.70%	.000 (χ^2)
Hours of regular exercise	0.96 ± .58●	1.37 ± .71●	.019 (t test)
How often slip			.493 (χ^2)
never	20.70%	25.80%	
1-5 times a week	35.30%	43.54%	
1-2 times per week	17.10%	12.90%	
3-5 times per week	13.40%	11.29%	
more than 5 times per week	13.40%	6.45%	

* denotes indigenous n = 20 and non-indigenous n = 12, ▲denotes indigenous n = 45 and non-indigenous n = 37, ● denotes indigenous n = 27 and non-indigenous n = 43

Table 2. Intrinsic Risk Factors for falls of indigenous and non-indigenous communities

Characteristic	Indigenous (n=89)	Non-indigenous (n=68)	*P* (test)
Chair stand	9.36 ± .42	13.59 ± .55	.000 (t test)
Functional Reach (in.)	11.41 ± .36*	13.84 ± .43	.000 (t test)
4m walk (s)	4.50 ± .24	3.87 ± .20	.059 (t test)
Timed Up and Go	11.35 ± .61	8.26 ± .35	.000 (t test)
M-CTSIB condition 1 (EO,firm)	2.90 ± .13▲	2.17 ± .12▲	.000 (t test)
M-CTSIB condition 2 (EC, firm)	3.73 ± .20♦	3.39 ± .22♦	.274 (t test)
M-CTSIB condition 3 (EO, soft)	3.67 ± .14●	3.19 ± .20●	.052 (t test)
M-CTSIB condition 4 (EC, soft)	6.59 ± .33■	7.04 ± .47■	.419 (t test)

* denotes indigenous n = 78, ▲ denotes indigenous n = 86 and non-indigenous n = 61, ♦ denotes indigenous n = 80 and non-indigenous n = 60, ● denotes indigenous n = 79 and non-indigenous n = 59, ■ denotes indigenous n = 75 and non-indigenous n = 59.

APPENDIX

Demographic, Fall Risk, and Physical Activity Questionnaire

Client #_____

Age:_____ Gender: ☐ Female ☐ Male

Residence (Where do you live): _____

If you do not live in a city, what part of Humboldt/ Trinity/Del Norte County do you live in: _____

Are you physically active? ☐ Yes ☐ No (ex. Gardening, cutting wood, sweeping, walking dog)

If so, how many hours per day are you active? _____

Do you exercise regularly? ☐ Yes ☐ No

how many hours per day do you exercise on average? _____

Are you apart of a formal exercise class? ☐ Yes ☐ No

what is the name of that class? _____

FALL HISTORY

Are you fearful of falling ? ☐ Yes ☐ No

How worried are you of falling?

Not worried at all [ ]

A little worried [ ]

Somewhat worried [ ]

Very worried [ ]

Have you fallen in the past year? ☐ Yes ☐ No

How many time have you fallen in the past year? _____

Number of injuries in past year due to falls? _____

Number of Emergency Room visits in past year related to falls? _____

Number of hospital visits in past year related to falls? _____

If you fell in the past year……

Did the fall occur inside or outside? ☐ Inside ☐ Outside

Did you have dizziness when you fell? ☐ Yes ☐ No

How did the Fall occur?

_____

How often do you lose your balance, trip, slip or stumble?

☐ Less than 1-2 times per week ☐ 1-2 times per week ☐ 3-5 times per week

☐ More than 5 time sper week ☐ Other: _____

List any medications do you take:

_____

Check all that apply

Have you experienced any of the following	LAST WEEK	LAST MONTH	LAST YEAR
• Confusion or disorientation	[ ]	[ ]	[ ]
• Depression	[ ]	[ ]	[ ]
• Dizziness or vertigo	[ ]	[ ]	[ ]

To the best of your knowledge….

Do you take any Antiepileptic's or Benzodiazepine drug ☐ Yes ☐ No

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