

A Retrospective Case-Control Study of Porch Step Falls on the Fort Apache Indian Reservation. Gina Locklear, Class of 1990.

Injuries are the leading cause of death for American Indians and Alaska Natives. The age-adjusted injury death rate for Native Americans is approximately three times the all-US death rate. Injuries are also the second leading cause of hospitalization for Native Americans. Falls are the most common cause of nonfatal injuries and the third leading cause of fatal injuries in the US.² Among Native Americans, falls are also the leading cause of injury hospitalization and the sixth leading cause of injury deaths.⁹

The residents of the Fort Apache Indian Reservation (FAIR) of Central Arizona are not exempt from the burden of injury. A surveillance system of injury hospitalizations and deaths maintained on the reservation revealed falls to be the third leading cause of injury hospitalization and the second most costly type of injury to treat on the reservation. Because of the prominence of falls as a cause of injury on the FAIR, an in-depth analysis of falls occurring on the reservation was conducted. The analysis revealed that the fall related hospitalizations on the FAIR occurred at a rate of 6.4 per 1,000 population.⁴ In addition, fall related deaths occurred at a rate of 18.7 per 100,000 population *which* is almost four times the all-US fall death rate of 4.8 per 100,000.^{5,8}

The specific focus of falls from porch steps was chosen because this type of fall was the second most common type of fall injury, and it was believed that they lend themselves more readily to evaluation and possible environmental modification than other fall injury types occurring on the FAIR. The purpose of this study was to epidemiologically characterize falls from porch steps and, if possible, define environmental and physiological factors that contributed to the occurrence of this type of falls.

METHODS

The study population consisted of all individuals of Indian descent who reside on the Fort Apache Indian Reservation and who utilize the Whiteriver Indian Health Service (IHS) Hospital as a source of medical care. The case-subjects were those individuals in the study population who suffered a fall involving porch steps that necessitated hospitalization between January 1, 1987 to December 31, 1989. Twenty such cases were identified through data from the local injury surveillance system. It should be noted that any fall during this time frame that required hospitalization and whose cause was unclear or nonspecific in nature was investigated to determine if porch steps were involved. No additional cases were identified.

To evaluate these porch steps falls, a data collection form with medical and pharmacy input and literature review was developed. All case-subjects were investigated for physiological status at the time of their fall. Physiological data was obtained via review of medical chart and interview. The environmental condition of the porch steps was evaluated via the data collection form as well. This section of the data form was developed on the basis of literature review and included several measurements. All case-subjects and control-subjects were evaluated for the environmental condition of their porch steps.

Control subjects were selected from the study population and were matched to cases by gender and age. The specific selection criteria included the same gender and the same age (plus or minus 2 years) as the case-subjects. This selection criteria controlled for possible confounding variables (i.e. age and gender) and allowed for a larger pool from which to select possible controls. This is particularly advantageous with cases over 55 years of age. Four controls were selected for each case in order to compensate for the small number of cases.

Potential controls were selected through the hospital RPMS (Resource Patient Management System) ester system which keeps records of all hospital users. A program sort function on gender and age was performed for each case which provided subsets for control selection. A simple random sampling technique was employed to select controls. Controls were randomly selected from each subset population until 4 control-subjects met the selection criteria, which was the presence of a porch and porch steps at their residence. A total of 350 site visits of selected control homes were required to obtain the 80 controls.

Data from all data collection forms were entered into the EPIINFO Version 5 computer program for analysis.

RESULTS

General Characteristics of the Cases:

The gender distribution was 60% (12) female and 40% (8) male. The average age of a case-subject was 52 years old. 60% (12) of the cases were 50 years old or older and of those 50 years old or older, 58% (7) were female. 30% (6) of the falls occurred at night. Of those six occurring at night, 67% (4) had a nonfunctional outside light bulb. 50% (3) of those who fell at night had no indoor plumbing. In two cases (33%), an individual fell at night while going to the outhouse and in which there was not a functional light bulb. In addition, every case that occurred at night was alcohol involved. The medical care cost of 80% (16) of the cases to IHS was \$53,156.62. Cost information for the remaining 4 cases (20%) was not available at the time of the study.

Physiological Assessment of the Cases

The physiological factors in Table 1 were noted for each case. Several physiological factors appeared noteworthy:

- a. 55% (11) of all fallers suffered from hypertension. Four individuals were treated with medication while others were treated through diet.
- b. 75% (15) of all fallers suffered from poor vision. In 20% (4) of the cases the diagnosis could not be established (i.e. no eye exam). Only 2 fallers were wearing corrective lens at the time of their fall.
- c. 50% (10) of the cases were taking some form of medication. The type taken varied and no pattern was apparent.
- d. 55% (11) of cases suffered 1 or more serious injuries within the last three years.
- e. 55% (11) of the falls were alcohol (ETOH) involved. A fall was defined as ETOH if the bursa-stick test at the time of admission was positive and/or if the patient admitted to drinking prior to the fall.

Of the total cases, 90% (18) suffered from 2 or more of physiological factors. 75% (15) suffered from 3 or more factors and 60% (12) of the fallers suffered from 4 or more of the listed physiological factors.

Table 1: PHYSIOLOGICAL FACTORS IN FALLS

PHYSIOLOGICAL FACTORS CASES			
	Present o	Not Present %	Unknown
Poor Vision (diagnosed)	75	5	20
Hypertension	55	45	
ETOH (Alcohol) Involved	55	45	
Previous Injuries	55	45	
Medication Taken	50	50	
Arthritis	25	75	
Use of Walking Aid	20	80	
Overweight	15	85	
Foot/Leg Problems	15	85	
Bad Back	10	90	
Diabetes	5	95	
Epilepsy	5	95	
Heart Disease	0	100	

TABLE 2: Possible Contributing Environmental Factors

ENVIRONMENTAL FACTORS	CASE	CONTROL
Home		
Age of Home	15.4 yrs	18.9 yrs
Number of Occupants	2.95/home	4.6/home
Steps		
Average Tread	0.93 ft.	1.61 ft.
Average Riser	0.52 ft.	0.57 ft.
Average Width	4.05 ft.	5.87 ft.
Average Height	1.72 ft.	1.85 ft.
Number of Steps	3.13	2.48
Levelness (level)	39%	66%
Handrails (% with)	0	32
Construction:		
Wood	67%	61%
Concrete	27%	29%
Metal	6%	10%
Porch Size	79.73 sp. ft.	93.62 sp. ft.
Porch Construction:		
Wood	62%	58%
Concrete	38%	42%
Outward Opening Doors	0	0
Skid Strip on Steps	0	0
Operable Porch Light	40%	75%
Indoor Plumbing (Yes)	55%	95%

DISCUSSION

While the number of cases included in this study is small, one must remember that the reference population is only about 13,000 and that only falls from porch steps resulting in hospital admissions were included in the study.

Falls are usually the result of the interaction of many factors, including environment, previous experience, judgment, vision, hearing, strength, neurologic and cardiovascular status, polypharmacy, and others.^{3,6} Thus it may be inappropriate to look for a single cause for a fall. In this study, an attempt was made to identify both physiological and environmental factors (Tables 1 and 2).

While no direct association (i.e. cause-effect relationship) can be established between the physiological factors and the occurrence of a fall, several factors (such as hypertension, poor vision, alcohol involvement, number of previous injuries, and medication) could be considered contributory. This statement is made on the basis that the above mentioned physical conditions existed in a high percentage of the cases (i.e., 55% or more).

One physiological factor that warrants additional comments is vision. According to Archea, the whole process of transition from walking on a level landing to walking down a flight of stairs can be viewed as an integrated "visual" and "kinesthetic" test. In a "visual" test, a person has to look directly at the stair and assess the present condition of the stair prior to descending/ascending.¹ It would follow that if an individual's vision was impaired (i.e. because of disease or alcohol) then the ability to negotiate steps is diminished and could contribute to a fall.

In addition, the fact that many cases suffered from multiple physiological factors could be considered significant. Literature from other studies have stated that the risk of falling can be increased by multiple medical problems because the person's overall functional status is limited. Often times any single factor (or problem) which normally would be considered minor can tip the balance and lead to one or a series of falls.⁶

As noted in the results section, the cases were unevenly distributed among the reservation communities, with the East Fork community being the recipient of over 50%. Not only did East Fork have a higher percent of cases, but the majority of the elderly who fell resided in East Fork, as did those individuals whose falls were alcohol involved. Reasons for these facts cannot be readily determined and, in fact, could prove elusive. It is known that the elder population in the East Fork community is not over represented when compared to other reservation communities. This dispels the notion that more elderly are falling in East Fork because East Fork has a large elderly population. Other plausible explanations that might account for these facts could be gained by examining the socioeconomic factors (i.e. unemployment, alcohol consumption, self-motivation, and general attitude toward the maintenance of surroundings) of this community as compared to other reservation communities.

The type of housing is another variable that has some association with the occurrence of a fall. As previously stated, private homes and HIP homes are over represented in terms of cases. Reasons for this may arise from the differing construction practices. Most often privately built homes are built by owners who do not conform to any particular standards with regard to the tread, riser, and width of steps. HIP homes, until the last five years, were built by different contractors. Presently they are built by the Skill Center whose basic purpose is to provide job training and hands-on experience to participants in the center's programs. The HIP program does not have a final inspection prior to turning the homes over to recipients who are either handicapped or elderly individuals.

When examining the tread of the steps, the cases had an average tread that was 72% shorter than the controls. The tread standards from the National Fire Protection Association⁷ are met with respect to the cases but are exceeded with respect to the controls. According to Archea, if one places one's foot too far forward on any of the treads, there will be insufficient support to carry the weight of the body and forward momentum will force the foot over the edge or nosing. If people place their feet too far back on any tread, they may trip over the nosing when they attempt to swing that foot to a tread further below.¹ It could be speculated that a fall occurred as the result of individuals, particularly elderly, placing their foot too close to the edge because of a short tread.

Another step dimension that appeared significant is average width. The controls in this study are almost 2 feet wider than the cases. It was speculated that the wider step could allow one to fall down on the steps, as opposed to falling off the steps to the ground on narrower steps.

As noted in the results, all (100%) case-subject homes had no handrails in contrast to 2/3 of the controls. Handrails are important because they provide an individual with support and something to grasp which is of particular importance in people with gait or other extremity problems.

Although only 30% of the porch-step falls occurred at night, the necessity of adequate lighting is important. A large proportion of the cases did not have operable outside porch lights which thereby decreases an individual's visual acuity and increases the risk for a fall.

CONCLUSION

Because the factors that may have contributed to the occurrence of these porch-step falls are varied, it is impossible to identify a single effective intervention. Therefore, the following recommendations are made:

1. Share information from this study with the medical staff, optometrist, and pharmacists at the Whitexiver IHS Hospital. These direct health care professionals would be able to dispute/confirm whether the physiological data collected in this study is the "norm" of the population. Possibly encourage the physicians to assess for falls as part of routine history and physical exam, particularly for patients over the age of 50. In addition, encourage the medical staff to conduct a follow-up study to further investigate the importance of physiological factors in the occurrence of falls. Patients should be encouraged by physicians to have an eye exam periodically.
2. Follow-up with the HIP program to determine if specific step dimension standards can be used by the Skill Center when building homes in the future.
3. Implement a project, in East Fork or reservation-wide, to rebuild the steps of private and HIP homes in which people over the age of fifty reside.

REFERENCES

1. Archea JC: Environmental factors associated with stair accidents by the elderly. Symposium on Falls in the Elderly: Biologic and Behavioral Aspects. Clinics in Geriatric Medicine 1985;1(3):555-569.
2. Baker SP, O'Neill B, Karpf RS: The Injury Fact Book. Lexington MA, DC Health and Company, 1984, p.113.
3. Bennett WB (ed): All Fall Down. Harvard Medical School Letter, December, 1989, pages 4-6.
4. Dellapenna A: Cause of injury-related morbidity at the Whiteriver Service Unit, 1981-1988. Presentation to the Whiteriver Office of Environmental Health, November, 1990.
5. Dellapenna A: Cause of injury deaths at the Whiteriver Service Unit, 1980-1987. Presentation to the Whiteriver Office of Environmental Health, November, 1990.
6. Hindmarsh JJ and Estes EH: Falls in older persons: causes and interventions. Archives of Internal Medicine 1989;149:2217-2222.
7. National Fire Protection Association: 101 Life Safety Code Book. Chapter 22, Quincy, Massachusetts, 1985.
8. Preventing injuries due to falls. Public Health Macroview 1990;3(4):5.
9. Injuries Among American Indians and Alaska Natives. IHS Office of Environmental Health and Engineering, Rockville, 1990.