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# The Application of a Falls Risk Index

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# THE APPLICATION OF A FALLS RISK INDEX

by

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THE APPLICATION OF A

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This thesis is approved as a creditable and independent investigation by a candidate for the degree Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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Abstract

This study examined the prospective use of a falls risk index. The research question was: To what extent do the intrinsic factors identified in the Tinetti et al. falls risk index predict which patients are likely to experience a fall. Hogue's ecological model of falls in late life provided a conceptual framework for the study.

Direct observation was used to collect baseline data from a convenience/purposive sample of 26 male patients in a midwest nursing home care unit with a rehabilitation focus. Patients were then assigned to one of three risk groups: yes-fall, 30% chance of fall, no-fall. Reports of patient falls were reviewed during the following four months. Data were analyzed by discriminant analysis and frequency tables.

Actual occurrences were demonstrated to be consistent with predicted occurrences in the frequency tabulation, and 23/26 participants were classified correctly by discriminant analysis. There are several considerations in the interpretation of this data: (1) over half the sample was in the predicted middle-risk group (30% chance of falls) which has limited clinical usefulness, (2) the discriminant analysis equation was developed from study data, and (3) no variable contributed significantly to risk of falling in the stepwise entrance of variables analysis.

Nonetheless, predictability of the extremes (yes-fall or no-fall) using reproducible scales to evaluate risk factors was demonstrated, and may be useful clinically as well as in other studies of patient falls.

I give permission to the College of Nursing, SDSU to publish this abstract in a collection of abstracts from master's projects and theses.

Signature

Date

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# Chapter 1

## Introduction to the Research

This chapter includes an introduction to the problem, a statement of the problem, a discussion of the significance of the study, a description of the theoretical framework, definitions of terms, the study objectives, and the thesis organization.

### Introduction to the Problem

Falls which occur in long term care (LTC) facilities are a concern to nurses in the supervision of elderly patients in these settings. On a graph of death rate vs. age group for falls, there is a steep logarithmic ascent past age 65 (Nickens, 1985). Each year falls are given as the underlying cause of death for nearly 9500 individuals in this age group. Baker and Harvey (1985) report that falls initiate and/or contribute to a chain of events which culminates in death in an even greater number of cases. For ages 85 and older, at least 20% of fatal falls occur in LTC facilities. There are approximately 172,000 hip fractures each year resulting from a fall in people over age 65, and the cost of repair and rehabilitation of clients with hip fractures was estimated at 2 billion dollars in 1980. Fractures of the extremities associated with falls are also reported, though the rate is less than for falls with consequent hip fracture (Baker and Harvey, 1985). Soft tissue injury, sprains, contusions,

dehydration and pneumonia are also recognized as potential consequences of falls in the elderly (Gryfe, Amies, & Ashley, 1977; Melton & Riggs, 1985). Less easily measured, though noted in published studies, are the effects of falls on elderly persons mobility and independence, perhaps due to decreased confidence and the fear of falling again (Tinetti, Williams, & Mayewski, 1985), as well as mobility restrictions imposed by caregivers.

Estimates of annual rates of falling among the population in LTC facilities are as high as 668 per 1,000 residents per year (Gryfe et al., 1977), a higher rate than has been demonstrated in community-based studies. Evaluating the reports of falls in the literature is difficult - settings are not comparable, data are collected in different manners, and analyses of results conflict. Noting the high rates of falls in LTC facilities, even though this population is protected from many environmental (extrinsic) factors, investigators have begun studies of host (intrinsic) factors which may predispose this population to falling.

Tinetti et al. (1985) have identified nine factors from the literature and from their own study which, when considered in an additive manner, may identify those persons at risk for falling. This study examined the application of this falls risk index in a Veterans Administration Nursing Home Care Unit (NHCU).

## Statement of the Problem

To what extent do the intrinsic factors identified in the

Tinetti et al. (1985) falls risk index predict which patients are likely to experience a fall?

## Significance of the Study

One objective of a clinical prediction rule is to estimate the probability of an outcome, specifically a fall in this study (Wasson, Sox, Neff, & Goldman, 1985). An analysis of the Tinetti et al. (1985) falls risk index applied prospectively in another clinical setting is one way to test this particular prediction rule.

## Theoretical Framework

Hogue (1984) presents an ecological model of falls and mobility in late life which was developed specifically for institutional settings. The model illustrates a method of organizing personal competence and environmental factors, and the cognitive appraisal and subsequent coping and adaptation of individuals to their environment. Coping and adaptation affects functional health which has direct effects on features of competence and in turn may effect features of the environment (Figure 1).

Hogue (1984) describes the model as a variant of the ecological equation: $B = f(P,E,PxE)$. This equation states that behavior is a function of the person, the environment, and the interaction of the person and the environment.

According the Hogue (1984), the ecological model highlights

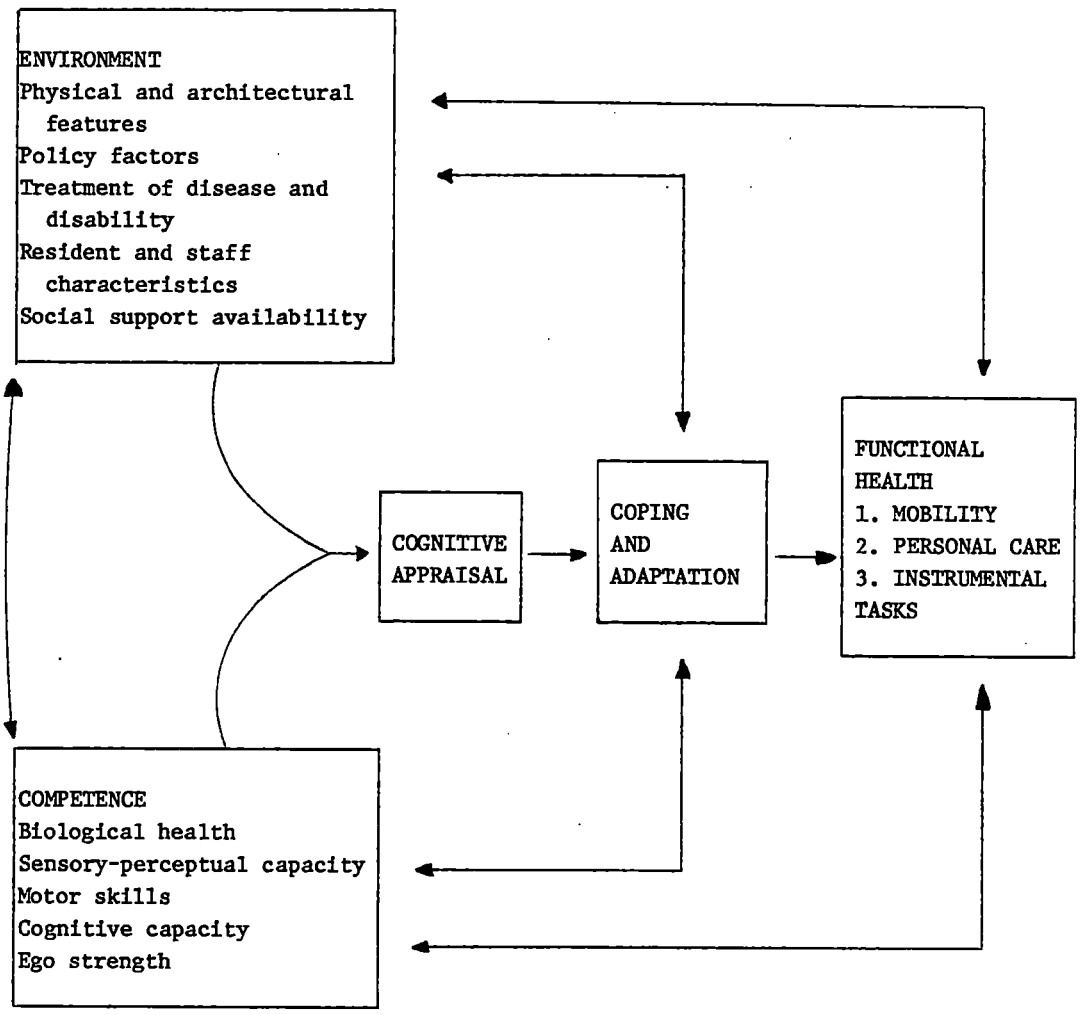


Figure 1. An ecological model for the enhancement of mobility, personal care, and instrumental tasks in an institutional setting.

Source: Hogue, C. C. (1984). Falls and mobility in late life: An ecological model. Journal of the American Geriatrics Society, 32(11), 858-861.

areas in need of study related to functional health, and specifically to falls in late life. Hogue's suggestions for operationalizing and measuring non-environmental variables are consistent with the risk factors in the Tinetti et al. (1985) index. This study then examined the relationship of personal or intrinsic factors to likelihood of falling, and in so doing investigated a portion of the Hogue (1984) model.

## Definitions of Terms

Falls. A sudden, unexpected change in position which results in the person who initiated movement of self coming to rest on the floor or ground.

Falls risk index. An additive, multidimensional profile of quantified clinical information used to identify those persons at risk for falls, developed by Tinetti et al. (1985). The factors in the profile are mobility, distant vision, hearing, morale, mental status, back extension, postural blood pressure, medications and activities of daily living (Tinetti et al., 1985).

Mobility. A combination of balance maneuvers and gait observations. An observer scores persons on each of 18 items and mobility is then represented by a score of 0-28, 0 being least mobile and 28 most mobile (Tinetti et al., 1985).

Distant vision. A subjective estimation of visual acuity using the Snellen chart (Duke-Elder, 1962). The acuity figure recorded is a comparison of a person's performance against a fixed

standard: V = d/D. (V = vision, d = fixed distance at which letters are read, D = distance at which letters should be read).

Hearing. The sense of sound represented by pure tone averages obtained by audiometry (American Speech and Hearing Association [ASHA], 1965):

| Hearing level | Descriptive term |
|---|---|
| -10 to 26 dB | normal |
| 27-40 | mild loss |
| 41-55 | moderate loss |
| 56-70 | moderately severe loss |
| 71-90 | severe loss |
| 91 or greater | profound loss |

Morale. A multidemensional state of mind which may be represented by a score of 0-17 on Lawton's revised Philadelphia Geriatric Center Morale Scale (0 is lowest morale, 17 highest). The three stable and replicable factors in this scale are agitation, attitude toward own aging, and lonely dissatisfaction (Lawton, 1975).

Mental status. A mental functioning requiring motivation, alertness, concentration and short-term memory. Screening of mental status may be done with the Set Test, and a score of 0-40 is assigned. A score of less than 25 corresponds with the clinical diagnosis of dementia (Isaacs & Kennie, 1973).

Back extension. The arc of motion in the dorsolumbar region as followed with a goniometer arm. Starting from the neutral

position, the person bends as far backward as possible. If the person cannot assume the neutral position, the degree of deviation is recorded when the person has extended the dorso-lumbar region as far as possible (American Medical Association [AMA], 1977).

Postural blood pressure. The measurement obtained using a standard mercury or aneroid sphygmomanometer and stethescope to record systolic and diastolic blood pressure, with persons in the following positions: lying (recumbent for 10 minutes with head elevated $< 15^{o}$), or standing (upright posture). A drop > 20 mm Hg in systolic pressure is postural or orthostatic hypotension (Blumenthal & Davie, 1980).

Medications. All agents listed on the medication record in the patient's chart.

Activities of daily living (ADLs). The areas of functioning which include bathing, dressing, toileting, transferring, continence and feeding (Katz, Downs, Cash, & Grotz, 1970).

## Objectives of the Study

The objectives of the study were:

1. To assess selected patients in a NHCU for fall risk factors.

2. To determine the frequency of falls among inpatients in the NHCU.

3. To apply the Tinetti falls risk index prospectively in predicting fallers.

4. To analyze characteristics that differentiate fallers from nonfallers in this facility.

## Organization of the Study

The organization of this study will be as follows:

1. Chapter 1 introduces the problem.

2. Chapter 2 contains a review of literature.

3. Chapter 3 describes the research design and methodology.

4. Chapter 4 presents the analyses and discussion of data, a summary of the study, and recommendations for further study.

In summary, this chapter has included an introduction to the problem, a statement of the problem, a discussion of the significance of the study, a description of the theoretical framework, definitions of terms, the study objectives, and the thesis organization.

# Chapter 2

## Review of Literature

This chapter presents reviews of selected literature on falls among the elderly, falls in long term care facilities, and host factors associated with falling.

### Falls Among the Elderly

There are numerous reports of falls among the elderly present in the literature. Isaacs (1983) has described this literature as lying in a zone of rapidly expanding ignorance. Perry (1982), while describing general trends in the literature, wrote that the literature is a compilation of descriptive studies . . . (which) offer differing estimates of the frequencies, causes and outcomes of falls. Venglarik and Adams (1985) similarly noted that analyses of the results of numerous studies on falls among institutionalized elderly conflict, and empirical validations of fall circumstances are disparate. Nickens (1985) observed that since the literature on falling is so varied, no partitioning scheme completely captures it. Nickens (1985) has, however, identified the following common issues in the literature:

1. Falling is an especial and common problem among the elderly, but is not benign. Probably one third to half of those over 65 years old suffer at least one fall per year.

2. Women fall at a greater rate than men but do not have as high a mortality.

3. There is not a time of day, season of the year, or location within the dwelling that is clearly associated with falling in all elderly populations.

4. The highest probability of falling may not be among the most chronically feeble elderly, but among those who are declining in mechanical competence and have not yet accepted or adjusted to their losses.

5. The relationship between a fall and death is probably an indirect one, even in the case of a fall and hip fracture.

6. Probably because of number 5, falls are rarely listed as a cause of death, greatly complicating investigation of the epidemiologic relationships between falling and various other factors.

7. Environmental hazards probably become decreasingly important in causing falls as age increases; conversely, intrinsic causes are more important as age increases. Environmentally caused slips and trips are probably uncommon as a sole cause of falling in the elderly.

8. While alcohol and drugs can increase the probability of falling, they do not appear to be central to the problem of falling in the elderly in the general population.

9. Because of numbers 5 and 7, mortality from falls in the elderly is frequently reflective of systemic pathologic conditions for which falling is a marker.

10. Following number 9, an increase in the number of falls (clustering) may be a marker for a terminal decline in health status.

11. Whatever the pathologic conditions for which falling is a marker, they seem also to manifest themselves in deterioration in gait and balance, including the proprioceptive-vestibular systems; perhaps deterioration of these systems provides the causal link between health status and falling. (p. 1092-1093)

In the fall of 1984 the National Institute on Aging sponsored a workshop on biologic and behavioral aspects of falls in the elderly, and subsequently papers presented were published. Recurring themes of this symposium included (Hadley, Radebaugh, & Suzman, 1985):

1. The need for a standard typology of falls to be used in testing hypotheses about the relationship of specific deficits to different types of falls.

2. The need to use the concept "faller" with precision, particularly in identifying frequent and infrequent fallers.

3. The need for longitudinal studies to assess the functional status of individuals prior to falling. (p.497-498)

## Falls in Long Term Care Facilities

Long term care facilities have an extremely heterogeneous

population, and this heterogeneity exists even within various administrative classifications (Manton, Liu, & Cornelius, 1985). Therefore, when reviewing the literature, settings described as a residential home, skilled or intermediate nursing care, or home for the aged were all considered LTC facilities, acknowledging that the populations and care given were potentially quite different.

Gryfe et al. (1977) conducted a five-year prospective study of falls among an ambulatory institutionalized population over age 65 and reported an annual fall rate of 668 incidents per 1,000 persons per year. The majority of fallers in this study experienced more than one fall, leading the authors to support the notion of a liability to fall as a syndrome which must be considered as a problem distinct from the opportunity to fall. There appeared to be a clustering of falls prior to death in some subjects who had multiple falls. This syndrome was supported by the findings of Venglarik and Adams (1985) who reported an incidence of falls of 1,292.24 per 1,000 persons at risk per year in a 175-bed skilled nursing facility, and half of these fallers fell more than once.

Kalchthaler, Bascon, and Quintos (1978) reviewed three months of reports of falls in a 200-bed "modern" LTC facility with both skilled and intermediate care beds. Fall rates were not reported in a comparable manner. These authors concluded that old people fall because of such host factors as decreased visual or auditory

acuity, impaired judgment, mental confusion, prolonged reaction time, impaired muscle coordination and declining strength . . . certain drug therapies compound these risks. Several of these host factors were also presented by Berry, Fisher, and Lang (1981). They concluded that changes of aging in gait, muscular and postural control, sight, and hearing were major risk factors in the elderly population.

Margulec, Librach, and Schadel (1970), in an earlier study of accidents among residents of homes for the aged, concluded that in a majority of falls the host-linked (internal) factors were more emphasized than the environmental (external) factors. Nickens (1985) similarly suggested recently that while environmental causes for falling have a commonsense appeal, it is likely that intrinsic (host) factors become more important with age.

Instrinsic Factors Associated with Elderly Fallers

The intrinsic factors used as independent variables in this study were identified by Tinetti et al. (1985); represent the work of various researchers; and include mobility, distant vision, hearing, morale, mental status, back extension, postural blood pressure change, medications and activities of daily living. Table 1 identifies selected literature on falls among the elderly and the intrinsic or non-environmental factors used in this study as predictors of risk of fall. (Note: Most studies did not look at all the factors, but rather focused on one or more aspects.)

Table 1

Studies Supporting the Use of Nine Variables in Falls Risk Index

| Study | Mobility | Distant Vision | Hearing | Morale | Mental Status | Back Extension | Postural B. P. Changes | Medications | Activities of Daily Living |
|---|---|---|---|---|---|---|---|---|---|
| Wild, Nayak, & Isaacs (1980) | X | X | | | X | | X | X | X |
| Kalchthaler, Bascon, & Quintos (1978) | X | X | X | | | | | X | |
| Imms & Edholm (1981) | X | | | | | | | | |
| Guimares & Isaacs (1980) | X | | | | | | | | |
| Macdonald (1985) | X | | | | | | | X | |
| Davie, Blumenthal, & Robinson-Hawkins (1981) | | | | | | X | X | X | |
| Wells, Middleton, Lawrence, Lillard, & Safarik (1985) | | | | | | | | X | |
| Ryden (1984) | | | | X | | | | | X |
| Thomas, Hunt, Garry, Hood, Goodwin, & Goodwin (1983) | | | X | X | X | | | | |
| Corbin, Reed, Nobbs, Eastwood, & Eastwood (1984) | | | X | X | X | | | | |
| Margulec, Librach, and Schadel (1970) | | | | | | | | | X |

Mobility impairments, as represented by gait and balance, are identified as distinguishing fallers from non fallers, and may in fact be the most useful observation (Tinetti et al., 1985; Imms & Edholm, 1981; Wild et al., 1980; Guimares & Isaacs, 1980). Table 2 presents an overview of the neural mechanisms hypothesized as controlling the complex function of gait and balance.

Table 2

Neural Mechanisms Controlling Gait and Balance

Afferent

- Visual input
- Vestibular impact
- Cervical mechanoreceptors
- Limb proprioceptive and tactile input

Central Integration

- Sensory and association cortex
- Thalamus
- Basal ganglia
- Cerebellum
- Brain stem postural control centers
- Spinal cord gait generator

Efferent

- Motor cortex
- Descending motor pathways from cortex (corticospinal tract)
- Brain stem pathways influencing posture and gait

Source: Wolfson, L., Whipple, R., Amerman, P. Kaplan, J., & Kleinberg, A. (1985). Gait and balance in the elderly: Two functional capacities that link sensory and motor ability to falls. Clinics in Geriatric Medicine, 1(3), 650.

While the effects of age on these structures has not been defined, the effects of certain deficits are summarized below (Wolfson et al., 1985):

> Abnormalities of multiple modalities of sensory input may make sensory dysfunction an important aspect of gait and balance failure . . . deficits in the central integration of motor and sensory functions are likely to be a major factor in the slow, poorly organized gait and balance responses observed in some elderly individuals . . .. Lesions of the motor cortex or its descending pathway produce characteristic gait abnormalities . . . objective measurements of gait and balance in the elderly may allow us to determine their role in falling. (p. 650)

Visual and/or hearing impairments, while acknowledged to either characterize fallers or contribute to falls (Wild et al., 1980; Kalchthaler et al., 1978), are not reported in quantified manners.

Morale is not directly mentioned in falls studies other than that of Tinetti et al. (1985). In a study of moral among institutionalized elderly, Ryden (1984) identified socioeconomic status, health status, functional dependency, length of institutionalization, and perceived situational control of daily activities as variables that influence morale. Many of these separate variables are reported in falls studies, although in

noncomparable manners and with conflicting conclusions.

Mental status, as measured by the Set Test, has been identified as differentiating fallers from nonfallers (Wild et al., 1980), and was therefore included in the Tinetti et al. (1985) study. However, there is no discussion of Set Test score and fall status in the latter study.

Postural blood pressure changes have been observed in fallers (Tinetti et al., 1985; Wild et al., 1980; Blumenthal & Davie, 1980). While postural blood pressure regulation is considered to be primarily under autonomic nervous system control (Robbins & Rubenstein, 1984), there is evidence that with aging, changes in the vascular tree may be more important (MacLennan, Hall, & Timothy, 1980; Smith & Fasler, 1983). Medications with hypotensive actions are also associated with orthostatic hypotension (Wild et al., 1980; Wells et al., 1985), however, Macdonald (1985) has succinctly pointed out that a problem exists with the distinction between the effects of drugs and the effects of underlying disease, and a detailed knowledge of variations within groups of drugs remains distinctly inadequate.

Dependence in activities of daily living has been discussed in association with falls (Wild et al., 1980; Tinetti et al., 1985; Venglarik & Adams, 1985; Margulec et al., 1970), specifically in relation to continence, toileting activities and transferring, these investigators however seem to support the adage that concomitance does not imply causality.

The need to quantify these variables and clearly describe samples and settings in order to facilitate comparable and reproducible studies is evident in this review of literature. Congruent methods of doing this have been suggested (Hogue, 1984; Tinetti et al., 1985) and were used in this study.

This chapter has presented a review of selected literature on falls among the elderly, falls in LTC facilities, and host factors related to risk of falling.

# Chapter 3

## Methodology

This chapter discusses the setting, sample, data collection instrument, research design and procedure, assumptions and limitations of the study.

### Setting

The setting for this study was a 75 bed Veterans Administration Nursing Home Care Unit (NHCU) with a rehabilitation focus. Individuals are generally admitted to this unit after hospitalization and receive services such as speech, physical therapy and occupational therapy as well as medical and nursing care. There is a 95% patient turnover within a twelve-month time, with individuals generally discharged to community nursing homes or their own homes once it is felt a maximum level of functioning has been achieved.

The NHCU has two floors - one has wide hallways and doorways for individuals with mobility impairments requiring the use of wheelchairs or walkers and has a R.N. or L.P.N. to patient ratio of 1:6. The other floor is restricted to individuals not requiring assistive devices for mobility and able to perform activities of daily living with minimal assistance, and is staffed with a R.N. or L.P.N. to patient ratio of 1:34.

## Subjects

A convenience/purposive sample was used in this study. All patients in the NHCU July 15-July 31, 1985 were included except: (a) those who were not expected to or did not remain in the facility for the study period, (b) those who were unable to transfer themselves from bed to chair, and (c) those who refused to participate.

It has been demonstrated that medical diagnoses are not reliable in defining service utilization in nursing homes (service utilization is presumed to be related to functional attributes) (Manton et al., 1985) and therefore the sample was not characterized nor analyzed in this manner. The study sample included 26 male residents with an age range of 56-93 years.

## Data Collection Instrument

The research instrument used in this study was a falls risk index developed by Tinetti et al. (1985) to assess nine intrinsic variables believed to be significant, when considered in an additive manner, in predicting individuals at risk for falling. Definitions of each factor are found in Chapter 1 of this study. In order to avoid biases which may be introduced when data sources are varied (Rubenstein, Schairer, Wieland, & Kane, 1984), care was taken to collect data in the manner described in original written accounts of the respective instruments. Instruments for data collection are found in Appendix A. Table 3 summarizes the

Table 3

A Summary of Measurements in Falls Risk Index

| Risk Factor Measured | Reference | Scale | Measurement Tool | Assessment of Measurement | | Risk Factor |
|---|---|---|---|---|---|---|
| | | | | Reliability | Validity | |
| Mobility | Tinetti et al. | 0-28 points | nurse and physicians, using Tinetti mobility scale | inter-rater variability <10% | content, based on judgement of experts | <19/28 |
| Back Extension | AMA | 0-90 degrees | physician, using goniometer | | content review of literature and judgement of experts | < $30^{o}$ or symptoms |
| Postural B.P. Change | Robbins & Rubenstein | 0-00 mm Hg | nurse, using aneroid sphygmomanometer and stethescope | | | systolic drop ≥ 20 mm Hg or symptoms |
| ADLs | Katz et al. | 0-6 points | nurse, using Katz independence in ADL scale | demonstrated coefficients of reproducibility .948 and .976 | | > 2/6 |
| Hearing | ASHA | -10-80 dB | audiologist, using GSI 10 audiometer | | criterion by International Organization for Standardization | > 40 dB |
| Distant Vision | Duke-Elder | 20/20-20/100+ | optometrist, using Snellen test | | criterion - positive correlation with other estimates of acuity | > 20/30 in both eyes, corrected |
| Medications | Tinetti et al. | 0-4 points | nurse, by chart review to identify sleepers, benzodiazepines, antidepressants, antipsychotics | | content based on review of literature | > 0/4 |
| Morale | Lawton | 0-17 points | nurse, using revised Philadelphia Geriatric Center Morale Scale | internal consistency of 3 morale factors assessed - Cronbach's alpha of .85, .81, .85 | | < 10/17 |
| Mental Status | Isaacs & Akhtar | 0-40 points | nurse, using Set Test | | criterion, positive correlation with other psychological tests | < 25/40 |

measurement tools included in the falls risk index. Brief descriptions of these tools follows:

1. Mobility. The mobility assessment and score developed by Tinetti is based on work by previous investigators (Wild et al., 1980; Imms & Edholm, 1981; Guimares & Isaacs, 1980) and was represented by the combined score of balance maneuvers (15 possible points) and gait observations (13 possible points). Inter-observer variability for this tool was reported to be less than 10% (Tinetti et al., 1985). All assessments in this study were done by one physician. A score < 19/28 represented a risk factor.

2. Back extension. One physician, using a goniometer, assessed motion in the cervical and dorsolumbar regions of all subjects. It is accepted that a certain amount of subjectivity is present in this assessment. Moderately decreased extension (< $60^{o}$ in cervical region, < $30^{o}$ in dorsolumbar region) or symptoms of dizziness or imbalance were considered to be a risk factor.

3. Postural blood pressure change. The blood pressure of all individuals were taken by one nurse investigator and were measured with subjects lying and standing. A systolic pressure drop > 20 mm Hg after one minute of standing, and/or the presence of symptoms such as lightheadedness, weakness or dizziness were considered to represent a risk factor.

4. Activities of daily living (ADL). The index of Independence in Activities of Daily Living (Katz et al., 1970) was

used to identify dependence or independence in the six ADL's of bathing, dressing, going to the toilet, transfer, continence and feeding. When assessed in the order given, these items form a guttman scale and coefficients of reproducibility of .948 and .976 have been demonstrated (Kane & Kane, 1981). The number of activities with which the subject needs help were recorded by chart review, and a score > 2/6 represented a risk factor.

5. Hearing. Audiometry was done on all subjects by one audiologist using a GSI 10 audiometer. Data was recorded by chart reviews. Hearing levels > 40 dB (moderate hearing loss) represented a risk factor.

6. Distant vision. The Snellen test was done on all subjects by one optometrist or one assistant to the optometrist. The subjective assessment by the optometrist was that visual acuity was similarly measured by both individuals. Data was recorded from chart review. Distant vision > 20/30 in both eyes, corrected, represented a risk factor.

7. Medication. The classifications of medications was done after chart review. The routine use of sleepers, benzodiazepines, antidepressants or antipsychotics was considered a risk factor.

8. Morale. The revised Philadelphia Geriatric Morale Scale (Lawton, 1975) was administered verbally and in privacy by one nurse to all subjects. The three morale factors assessed in the 17 item scale - agitation, attitude toward own aging, and lonely dissatisfaction - were demonstrated to have a high degree of

internal consistency as determined by Cronbach's alpha: .85, .81, and .85 respectively (Lawton, 1975). A score < 10/17 represented a risk factor.

9. Mental status. The Set Test (Isaacs & Kennie, 1973; Isaacs & Akhtar, 1972) was administered verbally by one nurse to all subjects, in privacy. Positive correlation of this test with various other psychological tests has been demonstrated. Low scores on this test correspond closely with a clinical diagnosis of dementia (Isaacs & Akhtar, 1972). A score < 25/40 represented a risk factor.

## Research Design and Procedures

This study was designed to collect data by observation, using established, quantified measurements of nine factors which could be considered as independent, continuous variables. The presence or absence of fall was the dichotomous dependent variable. This design enabled data to be analyzed by discriminant analysis.

Permission to conduct this study was obtained by filing a South Dakota State University (SDSU) "Determination of Research Involvement with Human Subject" form and an "Information About" sheet was prepared as described by the Western Research and Development Office and was submitted to the Sioux Falls Veterans Administration (VA) research committee (see Appendix B) by both SDSU and the VA. Both institutions determined that no participants were at risk as a result of their participation in

this study. Subjects were given a verbal explanation of the study by the physician, witnessed by the nurse investigator, and were asked to give verbal consent for participation. No individual refused to participate.

Baseline assessment data, which included observations, measurements, interviews and chart review previously described, were obtained from July 1-July 31, 1985. Incident reports of falls were reviewed from August 1-November 30, 1985. Anonymity of subjects was protected by recording individual data with coded numbers, and by reporting group scores only. Data were analyzed by computer using the Statistical Analysis System (SAS) available at SDSU.

## Assumptions

The following assumptions were made in this study:

1. Environmental risk factors for falls had been minimized in this facility.

2. The data collection tools included in the research instrument did actually measure the respective attributes.

## Limitations of the Study

1. A fall is a momentary event which cannot be studied until after it occurs. Accordingly, assessments of risk factors which change over time are not always measured immediately preceding a fall.

2. Distinctions between fallers and nonfallers are dependent

on the time interval studied - everyone will probably fall if given a long enough time period in which to do so.

3. The sample may not be typical of the population with regard to the nine independent variables.

4. Assessments of the nine factors were not done by evaluators who were blinded to knowledge of previous fallers.

This chapter has included a description of the setting of the study, the sample, the data collection instrument, research design and procedures, and assumptions and limitations of the study.

# Chapter 4

## Conclusion of the Study

This chapter presents a description of the sample, analyses of data, discussion of the study findings, summary of the study and recommendations.

### Description of the Sample

The convenience/purposive sample for this 4-month study consisted of 26 men, aged 56 to 93 years, in a midwestern V.A. LTC unit (see chapter 3). Table 4 presents numbers of patients, fallers and nonfallers by age group.

Table 4

Fallers and Nonfallers Categorized by Age Group

| | 55-64 | 65-74 | 75-84 | 85+ | Total |
|---|---|---|---|---|---|
| Fallers | 2 | 3 | 4 | 0 | 9 |
| Nonfallers | 3 | 5 | 4 | 5 | 17 |
| Total | 5 | 8 | 8 | 5 | 26 |

### Analyses of Data

Each subject in this study was scored on each variable based on the method described in chapter 3. Scores were determined by the use of pre-established scales with validity and reliability determined (see table 3). Data were then analyzed in two manners: (a) discriminant analysis, and (b) frequency table.

Faller and nonfaller group means, for each variable, derived from raw score totals, are presented in Table 5. The summary of stepwise selection of variables for differentiating fallers from nonfallers is presented in Table 6. With the entrance of all variables, Wilk's lambda equaled 0.53, and therefore was not as good as 50/50 probability.

Table 5

Group Means for each Variable, Fallers and Nonfallers

| Variable | Fallers (N = 9) | Nonfallers (N = 17) |
|---|---|---|
| Mobility | 17.9 | 20.2 |
| Back extension | 12.7 | 17.0 |
| Postural B.P. changes | 20.1 | 7.0 |
| Distant vision, right | 39.2 | 26.3 |
| Distant vision, left | 28.8 | 41.8 |
| Pure tone average, right | 43.4 | 35.1 |
| Pure tone average, left | 41.4 | 43.1 |
| Morale | 9.9 | 7.6 |
| Mental status | 31.3 | 33.5 |
| ADLs | 2.9 | 4.1 |
| Medications | 3.8 | 3.5 |

Table 6

Summary, Stepwise Selection of Variables
With Partial $R^2$, Wilks Lambda and Probability of Lambda

| Step | Variable Entered | No. in. | Partial $R^2$ | Wilks Lambda | Prob < Lambda |
|---|---|---|---|---|---|
| 1 | Morale | 1 | 0.14 | 0.86 | 0.06 |
| 2 | ADLs | 2 | 0.09 | 0.79 | 0.06 |
| 3 | Medications | 3 | 0.07 | 0.73 | 0.07 |
| 4 | Postural B.P. changes | 4 | 0.04 | 0.70 | 0.10 |
| 5 | Distant vision, left | 5 | 0.05 | 0.66 | 0.12 |
| 6 | Distant vision, right | 6 | 0.07 | 0.62 | 0.12 |
| 7 | Mobility | 7 | 0.06 | 0.58 | 0.14 |
| 8 | Pure tone average, right | 8 | 0.02 | 0.57 | 0.19 |
| 9 | Mental status | 9 | 0.04 | 0.54 | 0.23 |
| 10 | Back extension | 10 | 0.01 | 0.53 | 0.32 |
| 11 | Pure tone average left | 11 | 0.00 | 0.53 | 0.43 |

When considering the application of the derived discriminant function equation, 23 of 26 observations were classified correctly (i.e. 3 misclassified observations). The classification summary resulting from use of this equation is presented in Table 7. The rate of correct classification is not surprising, however, because the equation was developed from the study data set. As noted earlier in this study, clinical prediction rules, when used to estimate the probability of a particular outcome, must be substantiated prospectively in a different setting.

Table 7

Classification of Nonfallers and Fallers
Applying Discriminant Equation vs. Actual Occurences

| | Classification | | |
|---|---|---|---|
| | Nonfallers | Fallers | Total |
| Nonfallers | 14 (82%) | 3 ( 18%) | 17 (100%) |
| Fallers | 0 ( 0%) | 9 (100%) | 9 (100%) |
| Total | 14 (58%) | 12 ( 42%) | 26 (100%) |

A comparison of the Tinetti et al. (1985) fall risk index with actual occurrences is presented in Table 8. On the extreme ends, this tool appears to be a good predictor. (One actual fall, predicted as no fall, was a person with a blood sugar of 36 on examination after the occurrence. Not classifying this as a fall would change column 1 to 1:9:10.) The middle classification of unknown risk is the largest group. This may be in part attributed to a small sample size and as yet unknown factors affecting risk for fall. However, the 5/14 fallers in the unknown risk group is comparable to Tinetti's et al. (1985) findings of 30% in this group.

Table 8

Predicted vs. Actual Occurences, Using Tinetti Falls Risk Index

| | Predicted | | | |
|---|---|---|---|---|
| | No Fall | Unknown Risk | Yes Fall | Total |
| Fall | 2 | 5 | 2 | 9 |
| No Fall | 8 | 9 | 0 | 17 |
| Total | 10 | 14 | 2 | 26 |

Discussion of Study Findings

The ultimate measure of a clinical prediction rule is its clinical utility (Wasson et al., 1985). This tool is potentially usable in long term care facilities as a way to identify patients very likely or unlikely to fall. The majority of patients though, were grouped in the middle area in which falls could not be predicted. One value of this index then, is in predicting the extremes. Another value is in providing reproducible, quantified data sets with which to begin comparing falls and intrinsic factors among groups. This in itself represents a significant contribution towards the understanding of falls (see chapter 2).

This study also represents an initial step in the investigation of the Hogue (1984) model of falls in late life. Hogue (1984) identified potential uses of the model as providing a total assessment of persons in their environment, keeping in mind the general relationships between factors that affect functional health; and as highlighting areas in need of study. This study investigated only measurements of non-environmental portions of the model, and supports the notion of a relationship between diminished personal factors and falls in late life. Although this study did not include measurements of environmental risks, the study was conducted in one setting which has documented decreasing numbers of falls over the last 5 years with environmental modifications.

## Summary of the Study

This research was conducted to prospectively apply a falls risk index. Hogue's (1984) ecological model of falls and mobility in late life provided a conceptual framework for the study.

The literature review included discussions of falls among the elderly, falls in LTC facilities, and intrinsic factors being studied in relation to falls in late life. The lack of consistent findings in all three of these discussions was identified, as was the need for reporting of study findings in an objective manner using reproducible scales.

The research instrument was developed by Tinetti et al. (1985) and portions were noted by Hogue (1984) to be appropriate measurements. Baseline assessments were completed by a multidisciplinary team and falls were then monitored for four months. Data were analyzed by discriminant analysis and a frequency table. Using the equation developed from study data, 23/26 participants were correctly classified. However, this high predictability is based on the study data. Furthermore, no variable contributed significantly to risk of falling in the stepwise entrance of variables analysis.

## Recommendations

Based on the findings of this study it is recommended that:

1. The study be continued on a larger sample of elderly persons in LTC facilities, male and female.

2. Further research be done on the interrelationships of instrinsic factors included in the index.

3. Measurement of environmental factors be included in a predictive index.

4. Efforts be directed toward identifying factors which reduce the number of individuals in the middle area of risk for fall.

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# Appendix A

## Instructions for Data Collection

### Mobility Score

Balance. Subject is seated in hard armless chair. The maneuvers on the data collection sheet are tested.

Gait. Subject stands with examiner. Walks down hallway or across room, first at his/her "usual" pace, then back at "rapid, but safe" pace (using usual walking aid such as cane, walker).

Source: Balance and Gait Test developed by M. Tinetti for Falls Risk Study (unpublished). Obtained from Tinetti.

### Back Extension

Place subject in neutral position. Starting from neutral position have patient bend as far backward as possible, following range of motion with goniometer arm. Record end of arc of motion. If subject cannot assume the neutral position, record the degree of deviation and take a second measurement and record it when subject has extended the dorsolumbar region as far as possible.

Source: American Medical Association Committee on Rating of Mental and Physical Impairment (1977). Guides to the evaluation of permanent impairment. Chicago: American Medical Association.

### Postural Blood Pressure

General instructions: select a cuff with an inflatable bag of appropriate size. The width of the bag should be about 40% of the circumference of the limb on which the cuff is to be used -

12-14 cm in an average adult. The length of the bag should be about 80% of this circumference (range 60% to 100%). Center the inflatable bag over the brachial artery on the inside of the arm. The lower border should be about 2.5 cm above the antecubital crease. Position the subject's arm so that it is slightly flexed at the elbow and with a finger resting on the brachial artery, rapidly inflate the cuff to about 30 mm Hg above the level at which the pulsations disappear, deflate the cuff and note the palpatory systolic pressures. Inflate the cuff again to 30 mm Hg above the palpatory systolic pressure, then deflate cuff slowly, at rate of 3 mm Hg per second. Note systolic pressure at the level at which you hear the sounds of at least two consecutive beats. Continue to lower the pressure slowly until the sounds become muffled and disappear, the diastolic pressure.

Mercury sphygmomanometer: keep the manometer vertical and make all readings at eye level with the meniscus.

Aneroid instrument: Hold the dial so that it faces you directly.

Source: Bates, B. (1983). A guide to physical examination (3rd ed.). Philadelphia: J.B. Lippincott Company.

For lying pressures: have subject recumbent with head elevated $15^{o}$ for a minimum of 10 minutes. Record both left and right arm pressures.

For standing pressures: have subject change from recumbent

to upright, standing position and record right arm blood pressure at one minute and three minutes after position change.

For sitting pressures: (alternative blood pressure if subject is not able to stand) have subject change from recumbent position to sitting posture on edge of bed or in chair and record right arm blood pressure at one minute and three minutes after position change.

Source: Blumenthal, M. D., & Davie, J. W. (1980). Dizziness and falling in elderly psychiatric outpatients. American Journal of Psychiatry, 204.

Activities of Daily Living (chart review)

Identify subjects dependence or independence in the following activities: bathing, dressing, going to toilet, continence and feeding according to guidelines on data collection sheet.

Source: Katz, S. et al. (1980). Progress in development of index of ADL. The Gerontologist, 23.

Hearing (chart review)

Record audiologist's evaluation of hearing, and other data such as pure tones, reflexes and tympanogram if available.

Distant Vision (chart review)

Record optometrist's evaluation of distant vision, and other data such as near vision (Jaeger) or visual fields (II-4E spot as projected by Goldman perimeter).

Distant vision is assessed by having subject seated 20 feet

from the Snellen distance chart and, with each eye covered alternately, is asked to read the letters as far as he is able; both eyes are then tested together. The acuity figure is recorded as V = d/D (see definitions). The 20/20 letter is 8.86 mm overall and 1.77 mm in each of its component parts, and is the standard of comparison for all other letters.

Source: Duke-Elder, S. S. (1962). System of ophthalmology volume VII: Heredity, pathology, diagnosis and therapeutics. London: Henry Kimpton.

Medications (chart review)

Record all medications and dosages from medications record on subject's chart. Assign each medication an AHFS classification number from Drug Information 85.

Morale

Interviewer, alone with subject may state, "We are interested in the way you are feeling these days." Then verbally administer morale scale and record responses.

Source: Tinetti, Mary in Falls Questionnaire, unpublished.

Lawton, M. P. (1975). The Philadelphia geriatric center morale scale: A revision. Journal of Gerontology, 30(4), 85-89.

Mental Status

Interviewer, alone with subject may state, "Let's see how good your memory is." Then verbally administer Set Test and

record responses.

Source: Isaacs, B., & Akhtar, A. J. (1972). The set test: A rapid test of mental function in old people. Age and Aging, 222-226.

# Appendix B

Determination of Research Involvement
With Human Subjects
Graduate Program
College of Nursing
South Dakota State University

Definition of Human Subjects

This term describes any individual who may be at risk as a consequence of participation as a subject in research, development, or related activities. Subjects may include patients; outpatients; donors of organs, tissues and services; and normal individuals, including students or others who are placed at risk during training in medical, psychological, sociological, educational and other types of activities. Of particular concern and meriting special consideration are those subjects in groups with limited civil freedom. These include prisoners and residents or clients of institutions for the mentally ill and mentally retarded. Minors are also of particular concern. The unborn and the dead will be considered subjects only under conditions and to the extent permitted by law and regulation.

The proposed master's research project/thesis titled:

"The Application of a Predictive Falls Risk Index"

has been discussed regarding whether it involves human subjects. We (advisor and student) have determined that:

A. (Check one)

__X__ Human subjects are not involved because no individual will be at risk as a result of his participation in this study.

_____ Human subjects are involved because _____

B. (Check one)

_____ The student will initiate contact with the University Human Subjects Committee and proceed according to established University guidelines.

__X__ The student need not forward his/her proposal to the Human Subjects Committee.

Signature: Student

Date:

Signature: Project/Thesis Advisor

Date:

cc: Advisor
Student
Dean of Nursing's Office
Graduate Program Office

INFORMATION ABOUT, The Application of a Falls Risk Index.



You have been asked to participate in a research study on "The Application of a Falls Risk Index". The purpose of the study is to determine whether patients likely to fall can be identified by use of this index.

You will be asked to participate in a short evaluation of your balance. Your blood pressure will be recorded lying, sitting, and standing. We will ask you to turn your head and extend your back, and a brief interview will be conducted.

The results of the tests will be made available to your hospital physician. In this way, participation in the study may be of some benefit to you although the primary purpose of the study is to develop a means to identify patients at risk of falling. There are no anticipated risks to any of the participants in this study.

Your participation is entirely voluntary, and you may withdraw from the study at any time without prejudice. Withdrawal will not affect your medical care at this VA Hospital or any other institution associated with the University of South Dakota, School of Medicine.

Please feel free to ask any questions regarding this study which you may have. If you wish to question someone else not associated with this study, you may call Dr. Kevin Whittle, (605) 336-3230, ext. 211, or anyone else you may wish to ask. Your identity will not be revealed in any published or oral presentation of this study.

In the unlikely event that you are injured as a result of participation in this study, the Sioux Falls VA Medical Center will furnish medical care as provided by Federal Statute. Compensation for such injury will be available to you under the Tort Claims Act. For further information, contact the VA District Legal Counsel at (605) 336-3230, ext. 244.

I, _____, certify that the above written summary was discussed and fully explained to me by Dr. _____ on this date.

_____ _____
Date Signature

I, _____, the _____
(relationship/legal status)

of _____, certify that the above written summary
(subject's name)

was discussed and fully explained to me by Dr. _____

_____ _____
Date Signature

Thank you for your consideration.

CHARLES BEAUCHAMP, MD, PhD
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