Fall-related Factors among Older, Visually-Impaired Thais

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Abstract : There are multi-factorial factors, including decreased visual acuity, cardiovascular illnesses, metabolic diseases, declined physical strength, and environmental hazards, that have been recognized as risks for falls, especially among the elderly. Thus, this cross-sectional study aimed to examine, among older, visually-impaired Thais, potential predictors of falls, such as intrapersonal factors (visual function, chronic illnesses, physical performance, activities of daily living, and instrumental activities of daily living), interpersonal factors (social support), and extra-personal factors (home environmental hazards).

The sample consisted of 278 Thais, 60 years of age and older, living in Bangkok, Thailand and attending the eye clinics at three tertiary hospitals. Data were collected via interview, questionnaires, and physical assessment, and analyzed via descriptive statistics, chi-square, univariate analysis, ANOVA, and multiple logistic regression analysis.

The results revealed subjects experienced a 37.8 % prevalence of falls over the prior six months. The majority (65.84%) of participants were assessed as having moderate visual impairment (visual acuity = 20/70 - 20/200). Their most common eye diseases were cataracts (37.8%) and glaucoma (28.8%). Multiple logistic regression modeling revealed that only their physical performance significantly predicted a fall occurrence ($p<.001$; adjusted OR = 0.96; CI: 0.93-.99), with those with poorer physical performance having a higher risk of falls. The findings suggested the importance of nurses, in an effort to prevent falls, assessing the physical performance of older, visually impaired Thais.

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Introduction

It is well known that visual impairment is a major cause of falls among older adults.[1] Visual impairment has been recognized as a significant, international health problem among older persons, with approximately 65% of older individuals, the majority of whom live in developing countries, experiencing visual impairment.[2] Overall, approximately 46% of older Thais have been found to have some form of visual impairment, with approximately 36.6% of those who are visually impaired living in Bangkok.[3] Throughout Thailand,

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visual impairment, including eye disease, constitutes the seventh highest risk to long term disability among older Thais.[4]

Older, visually-impaired persons not only encounter limitations in mobility, activities of daily living (ADL), and physical performance, but also often experience psychological distress, especially anxiety and depression.[5] Visual impairment and the effects of falls may be connected to each other with respect to the increased occurrence of falls among older individuals. Thus, there is a need to investigate and better understand factors that lead to falls.

The severity of visual impairment one has can be determined through measurement of his/her: visual acuity; visual field; contrast sensitivity; and, depth perception.[6,7] As one may expect, decreased visual acuity, limited visual field, reduced contrast sensitivity, and restricted depth perception have been shown to contribute significantly to higher risks of falls.[1] However, prior studies have presented inconsistent findings.[8, 9] Given that the majority of the elderly have at least one chronic illness,[4] and that chronic illnesses can lead to declining muscular and neurological responses, it is not surprising that older individuals often experience compromised physical performance and function (i.e., ADL and instrumental activities of daily living [IADL])[10, 11] that may contribute to an increased risk of falls.

In addition to visual-impairment, the presence of chronic illnesses, home environmental hazards (i.e., poor lighting and ill-kept living space), and compromised physical function and performance have been recognized as factors that may be hazardous to older individuals, especially with respect to their risk of falls.[1] However, prior studies have not found an association between environmental hazards and the occurrence of injurious or reported falls.[12] Thus, since inconsistent reporting exists regarding factors that contribute to elders' falls, it is reasonable to further investigate personal factors that may influence the incidence of falls among elderly Thais.

Conceptual Framework and Review of Literature

The Neuman Systems Model (NSM) was applied, as the theoretical framework for this study, to describe the relationships between fall-related risk factors and the occurrence of falls among older, visually-impaired Thais.[13] According to the NSM, individuals are viewed as a system (i.e., an open, layered, multidimensional whole in constant dynamic interaction with positive and negative environments). Whereby, if one is unable to interact well with his/her environment, stressors will occur and the system will become imbalanced. The presence of a balanced system is the stability of the client system (i.e., the ability of an individual to effectively cope with a constantly changing environment). Thus, for this study, an older, visual-impaired Thai was viewed as a system in constant dynamic interaction with positive and negative environments. In addition, as older individuals experience natural physical decline through longevity, they are known to experience response limitations.[14, 15]

In this study, the environment was recognized as being comprised of three groups of stressors: intrapersonal stressors (physiological imbalance: lower extremity weakness; poor grip strength; functional impairment; and, visual impairment, in terms of severity); interpersonal stressors (psychosocial factors and social support); and, extra-personal stressors (inappropriate home environmental factors: poor lighting; untidy surroundings; and, lack of bathroom safety aid-devices). Therefore, visual impairment, comorbidity, physical performance, ADL, and IADL were recognized as intrapersonal factors, while social support and home environmental hazards were viewed as interpersonal and extra-personal stressors, respectively. In accord with the NSM, the three group of stressors might be postulated as fall-related factors as: intrapersonal factors (visual function, chronic illness, physical performance, ADL, and IADL); interpersonal factors (social support); and, extra-personal factors (home environmental hazards).

The intrapersonal factors (visual function, chronic illness, physical performance, ADL, and IADL), in this study, were viewed as one's personal response to demands placed upon his/her body. In that light, visual functions were recognized as the responses one has to what he/she sees, while vision was recognized as depending on the interaction of one's sensory and motor systems. A visual disturbance of either system could result in one experiencing postural instability that might cause a fall.[1] Prior studies have revealed that visual impairment of one's visual function (i.e., visual acuity,[16,17] contrast sensitivity, or depth perception) is a risk factor for falls.[1] Nevertheless, conflicting findings have been reported.[8,9]

Poor visual acuity,[16,17] poor contrast sensitivity,[1,17] and impaired depth perception[1] have been found to be significantly associated with older persons having increased risks for falls. For example, Thais with visual acuity < 20/50 have been found to have a 2.31 times greater risk for falls than those with normal vision.[18] On the other hand, studies of older, visually-impaired persons,[9] as well as of older, non-visually-impaired individuals, have not revealed a significant association between visual impairment and falls.[8] The inconsistencies of prior findings may be due to the use of different visual impairment criteria and research designs (i.e., cross-sectional and longitudinal).[1,16,17]

With respect to chronic illness, previous studies have demonstrated an association between falls and the health of older persons,[15,19] with a higher frequency of falls found among people 60 years of age and older, with diabetes mellitus.[20] Although no study could be located regarding older persons with diabetic mellitus and visual impairment, prior studies clearly have shown diabetes mellitus and increased age to be risk factors for falls.[15,19,20] The pathological changes brought about by progression of type-II diabetes and hypertension are known to cause decreased retinal and lens functioning, reduced muscle strength, and weakened nerve impulses.[21] Decreased peripheral sensation, among elders with clinically-diagnosed diabetes neuropathy, has been found to present risks for falls. Older diabetics also may experience hypoglycemia, which can precipitate events that may lead to a fall.[19] Older persons with hypertension also may experience side effects (i.e., dizziness) from anti-hypertensive medication, resulting in a fall.[22] In addition, the elderly who have multiple chronic illnesses, especially those with poor physical functioning, are known to experience higher rates of falls than those with good physical functioning, as well as being healthy and active.[22-24]

Physical performance has been recognized as a fall-related factor and defined as one's ability to perform tasks that include both gait and balance (e.g. sitting, standing, turning around, picking up items, standing on both feet, one leg touch, and one leg stand).[24] Thus, a physical performance impairment may be indicated when one has a decreasing, or lack of, ability to perform such tasks.[25]

ADL have been defined as the activities one performs in daily living, such as bathing, going to the toilet, transferring from bed to chair, and eating.[26] Strong associations between visual impairment and activity limitations have been found to occur more often among older, visually-impaired individuals than among those without visual impairments.[5] A longitudinal study revealed that visual impairment was predictive of a decline of functional ability, over time, among older individuals within a community.[27] In addition, the presence of functional limitations has been noted to be associated, not only with a fall, but also with recurrent falls.[27] Thus, one may conclude that functional performance, associated with the ability to perform ADL, is a fall-related factor among older, visually-impaired individuals.

IADL have been defined as the daily, independent activities one performs (i.e., walking outdoors, cooking, house cleaning, managing money, and accessing transportation).[26] Prior studies have revealed that functionally-limited older persons, living independently within the community, experience increased incidences of falls and recurrent falls.[18, 27]

The only interpersonal factor recognized, in this study, as potentially related to the incidence of falls among visually-impaired elders was social support. Social support was defined as the level of perceived supportive behavior provided, when needed, by another, including: intimacy, social integration, nurturance, worth, and assistance.[28] Lack of social support has been referred to as an interpersonal stressor that can influence falls among older, visually-impaired individuals.[13, 29] Prior studies have shown that individuals who fall, compared to those who do not experience falls, tend to receive less social support, including emotional, tangible, and/or overall support from their family members and friends.[30]

Extra-personal factors (home environmental hazards) were proposed, in this study, as contributors to falls among older, visually-impaired individuals. This was because such persons may be unable to adequately see to avoid hazards within their living space, leading them to trip, stumble, and/or fall.[12, 31] Prior studies have identified the existence of at least one environmental hazard in 80% of the homes of older individuals and more than five environmental hazards in over one third (39%) of such homes.[12, 31]

However, the evidence regarding environmental hazards, as a precipitant of increased falls, is not clear. Although a previous study noted no association between a variety of environmental hazards and the occurrence of injurious or reported falls,[32] -a Thai national survey revealed that environmental factors, within traditional Thai village homes (i.e., lack of electricity for the provision of adequate lighting), were main factors associated with falls among older Thais.[15]

In summary, prior findings regarding factors related to falls among older individuals have been inconsistent, especially with respect to the degree of older persons' visual impairments. Therefore, the aim of this study was to identify, among older, visually-impaired Thais, potential predictors of falls: intrapersonal factors (visual function, chronic illness, physical performance, ADL, and IADL); interpersonal factors (social support); and, extra-personal factors (home environmental hazards).

Method

Design: A cross-sectional descriptive design was used.

Ethical considerations: Prior to data collection, permission to conduct the study was granted by the Institutional Review Board of the primary investigator's (PI) academic institution and the Research Ethics Committees of each of the three tertiary hospitals selected as study sites. Potential subjects were informed regarding: the study's objectives; procedure and timing of data collection; what participation in the study would involve; anonymity and confidentiality issues; and, their right to withdraw from participation at any time without repercussions.

Setting and sample: The study sites included the eye clinics in three tertiary care hospitals in Bangkok, Thailand. The three study sites were randomly selected, following the 25% of total population "rule of thumb,"[33] from the 11 tertiary care hospitals in Bangkok. The three hospitals were selected because of the large number of visually-impaired elderly they service. A power analysis was performed to calculate the sample size, based on the fall prevalence of 19.8% among the elderly population in Bangkok,[19] a power level of 0.80, an alpha level of 0.05, and an effect size of 0.25. A minimum of 244 subjects was determined to be needed. An additional 10% was added to deal with possible attrition, resulting in a need for 268 subjects. As a result of the power analysis, and based upon the number of patients visiting the eye clinic daily, a convenience sample, selected consecutively, was applied to each clinic. The sampling process resulted in a total sample size of 278, with the hospitals contributing 169, 93, and 16 subjects, respectively.

Potential subjects who had physician appointments in the respective eye clinics were identified by the clinic nurses, so as to avoid violation of the potential subjects' privacy. Once the potential subjects were identified by the nurses, the nurses introduced the PI, who determined whether each potential subject met the inclusion criteria. The inclusion criteria included Thais who: were 60 years of age and older; had experienced visual impairment (visual acuity <20/70)[6] for > 6 months; had received treatment for at least one chronic eye disorder (i.e., cataract, glaucoma, age-related macular degeneration, or diabetic retinopathy); were cognitively intact (as measured by a score of ≥ 15 on the Chula Mental Test);[34] and, were attending the outpatient eye clinic of one of the three hospitals used as a study site. Potential subjects were excluded if they: had no light perception; were unable see light; had a hearing impairment; and/or, had a lower extremity physical disability or paralysis.

The participants were 60 to 96 years of age (mean = 74.41 years; SD = 7.57) and predominantly: female (n = 173; 62.2%); married (n = 154; 55.4%); living with their children and spouse (n = 223; 80.2 %); Buddhist (n = 260; 93.5 %); and, retired (n = 251; 90.3%). The majority of them: had less than an elementary school education (n = 176; 63.3%); had a family income of less than 5,000 baht per month (n = 171; 61.5 %; 30 baht = 1 USD); received financial support from their families (n = 178; 64.0%); and, received medical coverage from the Government Welfare or State Enterprise (n = 148; 53.2 %). Some of the subjects received universal coverage (n = 104; 37.4 %) for their healthcare expenses or paid out of pocket for medical care (n = 19; 6.8 %). Most of them had moderate visual impairment (see **Table 1**), with cataracts (n = 22; 7.9%) and glaucoma (n = 80; 28.8%) being the most common eye diseases. Almost all of the subjects had comorbidities (n = 260; 93.5%), with hypertension (n = 216; 77.7 %) and type-II diabetes mellitus being the most common (n = 150; 54.1%). Over one-third (n = 105; 37.8%) of the participants had fallen, with 8.3% (n = 23) having experienced two falls, and 2.5% (n = 7) experiencing more than two falls, within the past six months.

Table 1 Frequency and Percentage of Severity of Visual Impairment Among Participants (n=278)

Variables	Number	Percentage
Visual Acuity		
20/70 - 20/200	183	65.8
< 20/200 - 20/400	62	22.3
< 20/400 - 5/300	15	5.4
5/300- perception of light	18	6.5
Depth Perception		
Poor depth perception	183	65.8
Normal depth perception	95	34.2
Contrast Sensitivity		
Abnormal CS in low		
Spatial frequency	141	50.7
Normal CS	137	49.3

CS = contrast sensitivity

Instruments: Data were gathered using 11 demographic, physical, and psycho-social assessment measurements, including the: Chula Mental Test (CMT);[34] researcher-developed Demographic and Fall Occurrence Questionnaire (DDAFOQ); Snellen-Near Vision Chart (SNVC);[35, 36] Functional Acuity Contrast Test (FACT);[37] Titmus Fly Stereotest (TFS);[38] Cumulative Illness Rating Scale for Geriatrics (CIRS-G);[39] Berg Balance Scale (BBS);[25] Modified Barthel Activities of Daily Living Index (m-BADLI);[26] Chula Activities of Daily Living Index (CADLI); [26] modified version (m-PRQ)[10] of the Personal Resources Questionnaire;[28] and, Home Environment Hazards Questionnaire (HEHQ).[30]

The Chula Mental Test (CMT)[34] was used to determine the potential participants' cognitive functioning and whether they met the inclusion criteria. The CMT was a 13 item instrument that assessed: perception (four items: i.e., "Show a pen and ask what it is."); memory (three items: i.e., "How old are you?"); attention (three items: i.e., "Clap your hands three times."); language (one item: i.e., "Have the person read the words, umbrella, pan, and door."); and, recall (two items: i.e., Have the person repeat the following sentence: "I like flowers and music, but not dogs."). Responses to all of the items were either 1 = "Yes, they did the task or responded correctly," or 0 = "No, they did not do the task or respond correctly." A total score, which could range from 0 to 19, was obtained by summing the response values across all items. The total score indicated the level of cognitive impairment, whereby: 0 - 4 = severe impairment; 5 - 9 = moderate impairment; 10 - 14 = mild impairment; and, 15 - 19 = no impairment. The CMT took approximately 10 minutes to complete. The test-retest reliability for the CMT, in this study, was 1.00.

The Demographic Data and Fall Occurrence Questionnaire (DDAFOQ), developed by the PI, was used to obtain demographic information about the participants, as well as a history of each participant's fall occurrences. Demographic information obtained included each participant's: age; gender; marital status; living arrangement; religion; education; occupation; income; source of income; medical coverage; visual difficulties; and, comorbidities. It took approximately 10 minutes to complete the questionnaire. Information regarding fall occurrences was assessed by posing the question: "During the past six months have you fallen to the floor or ground, or encountered an unintentional change in position resulting in coming to rest at a lower level or on the floor or ground, other than by a consequence of an external force, hit, or attack?" Possible responses to this question were "yes" = 1 (fall occurrence), or "no" = 0 (no fall occurrence). The greater the number of fall occurrences, the higher the frequency of falls within the past six months.

The Snellen-Near Vision Chart (SNVC) [35, 36] was used to measure visual acuity (clearness of vision, which is dependent on the sharpness of the retinal focus within the eye and the sensitivity of the interpretation of the brain).[40] Use of the SNVC is a standard practice for measuring visual function. The chart consisted of 10 lines of descending size letters, with the top line being the largest and the bottom line being the smallest. When being assessed, the subject held the chart, with one eye covered, 14 inches from his/her eyes (equivalent of 20 feet of distance), which became the numerator of the fraction used to determine the subject's visual acuity. He/she then was asked to verbalize all the letters on the chart, starting with the top row and working down. All letters needed to be read accurately. The last row the subject could read indicated his/her visual acuity. The number to the right of each row of letters indicated the distance at which those with normal vision could read that row of letters. For example, if one can read row five, but not row six, he/she received a score of 20/30, meaning people with normal vision were able to read row five at 30 feet. The World Health Organization has classified visual acuity (VA) into five categories, whereby category: I = VA < 20/70 to >20/200; II = VA < 20/200 to >20/400; III = VA

< 20/400 to >5/300 (20/1200); IV = VA <5/300 (20/1200) to a minimum equal to or better than light perception; and, V = no ability to perceive light.[6] For scoring purposes, participants in category one received a code of zero (0), while those in all other categories received a dummy score of 1. Each visual acuity test took about 5 minutes to complete.

The Functional Acuity Contrast Test (FACT) [37] was used to assess contrast sensitivity (ability to detect subtle differences between objects that are not black or white). The FACT was a sine wave grating chart that examined five spatial frequencies (sizes) and nine levels of contrast. The subject determined the last grating seen for each row on the chart (A, B, C, D, E) and reported the orientation of the grating (right, up, or left). The last correct grating observed, for each spatial frequency, was plotted on a contrast sensitivity curve. For the purposes of coding, for this study, normal contrast sensitivity (low spatial frequency of 1.5 cycles/ degrees and in the normal area of the graph plot) was coded as zero (0), while poor contrast sensitivity (low spatial frequency of 1.5 cycles/degrees and in an abnormal area of the graph plot) was coded as one (1). It took the subjects approximately five minutes to complete the FACT.

The Titmus Fly Stereotest (TFS) [38] was used to assess depth perception or stereopsis (impression of depth perceived when an object is viewed with both eyes by someone with normal binocular vision). It is possible to appreciate the relative location of objects using one eye. However, it is the lateral placement of the eyes that provides two slightly different views of the same object (disparate images) and allows for acute depth discrimination. The TFS involved the subject looking through 3-D glasses at two polarized images (one for each eye) of a fly, displayed with disparities on the edges, to determine whether a 3-D figure could be seen. He/she then was asked to grasp the wings of the fly. The level at which the wings were grasped indicated the stereoacuity/depth perception level. Those with normal stereoacuity (40 seconds of arc) grasped the wings several centimeters above the Titmus test plane, whereas persons with less than normal stereoacuity/depth perception (<40 seconds of arc) grasped the wings closer to the test plane. Each participant was examined to determine if he/she had either normal depth perception (score of 3,600 seconds of arc) or a loss of depth perception (gross stereopsis) as indicated by a score of less than 3,600 seconds of arc, or being unable to catch the fly's wing. Depth perception was coded on a dichotomous scale where 0 = gross stereopsis (no loss of depth perception) and 1 = loss of depth perception. Since the subjects had low vision and were able to identify larger objects better than smaller objects, a cut-off point of 3,600 seconds of arch was used to measure abnormal stereoacuity.

The Cumulative Illness Rating Scale for Geriatrics (CIRS-G)[39] was used to assess comorbidity (presence of chronic illnesses; severity of each chronic illness; and, impact of each illness on the person). The CIRS-G consisted of 14 organ-specific categories (heart; vascular; hematopoietic; respiratory; ears, eyes, nose, throat, and larynx; upper GI; lower GI; liver; renal; genitourinary; musculoskeletal/integument; neurological; endocrine/metabolic; breast; and, psychiatric) rated on a 5-point scale, ranging from 0 = "no problem" to 4 = "extremely severe impairment or function." Scoring of illness severity was: 0 = no problem; 1 = current mild problems or past significant problems; 2 = moderate disability or morbidity that requires "first line" therapy; 3 = severe/constant significant disability or "uncontrollable" chronic problems; and, 4 = extremely severe/immediate treatment required, end organ failure, or severe impairment in functioning. Five main composite scores were calculated, including: total number of categories endorsed; total CIRS-G score; severity index (total score/number of categories endorsed); and, number of categories at level 3 severity (severity that is not compensated for with first line therapy) and at level 4 severity (immediate treatment required/end organ failure/severe impairment in functioning). The severity index score was used, in this study, whereby higher severity index scores demonstrated more severe functional impairment. Severity index scores were categorized into five levels: 0 - 0.49 = no problems with co-morbidity or chronic illness; 0.50 - 1.49 = current mild problems or past significant problems; 1.50 - 2.49 = moderate disability or morbidity; 2.50 - 3.49 = severe or constant significant disability or uncontrollable chronic problems; and, 3.50 - 4.00 = extremely severe/immediate treatment required, end organ failure state, or severe impairment in functioning. It took the subjects 5 to 10 minutes to complete the CIRS-G. To prevent errors from using the CIRS-G, inter -reliability (intra-class correlation) was accomplished prior to data collection. The PI interviewed and tested 30 older, visually-impaired Thais, revealing an intra-class correlation coefficient of one (1).

The Berg Balance Scale (BBS) [25] was used to assess physical performance (ability to perform a task that involved balance). The BBS involved performance and assessment of 14 specific tasks. Example items included asking the subject to stand from a sitting position, without using his/her hands for support (score range: 0 = "needs moderate or maximal assist to stand" to 4 = "able to stand without using hands and stabilizes independently") or stand still unsupported, for 10 seconds, with eyes closed (score range: 0 = "needs help to keep from falling" to 4 = "able to stand 10 second safely"). A total score, which could range from 0 to 56, was obtained by summing the numerical assessment scores across all items. A high score suggested good balance and low risk of falling. It took 15 to 20 minutes to complete the BBS. The reliability for this BBS, in this study, was 0.95.

The modified Barthel Activities of Daily Living Index (m-BADLI)[26] was used to assess everyday ADL, while the Chula Activities of Daily Living Index (CADLI)[26] was used to assess the more complex tasks of IADL. For the 10 items in the m-BADLI (i.e., grooming, toilet use, feeding, transferring, and walking) and five items in the CADLI (i.e., handling finances and housekeeping), participants were asked to what degree they could perform each task. Possible responses ranged from 0 = "unable to perform the task" to 3 = "can independently perform the task." A total score for the m-BADLI, which could range from 0 to 30, was obtained by summing the response scores across all 10 items. A total score for the CADLI, which could range from 0 to 15, was obtained by summing the response scores across all five items. High scores for both instruments indicated better functional ability. In this study, the reliability of the m-BADLI was 0.74, while the reliability for the CADLI was 0.77. It took the subjects 10 to 15 minutes to complete the m-BADLI and CADLI.

Part II of a modified version (m-PRQ)[10] of the Personal Resource Questionnaire[28] was used to measure social support (perceptions of supportive and tangible assistant given by others, such as family, significant others, and friends). The m-PRQ consisted of 25 items that measured: intimacy (five items: i.e., "There is someone I feel close to who makes me feel secure"); social integration (five items: i.e., "I spend time with others who have the same interests I do"); nurturance (five items: i.e., " I have the opportunity to encourage others to develop their interests and skills"); worth (five items: i.e., "I know that others appreciate me as a person"); and, assistance (five items: i.e., "If I need advice there is someone who would assist me to work out a plan for dealing with the situation"). Possible responses to each item ranged from 5 = "strongly agree" to 1 = "strongly disagree." A total score, which could range from 25 to 125, was obtained by summing the response values across all items. A high score suggested a level of perceived social support from others. It took the subjects 10 to 15 minutes to complete the m-PRQ. The reliability for the m-PRQ, in this study, was 0.92.

The Home Environmental Hazards Questionnaire (HEHQ) [30] was used to assess the presence of 28 environmental hazards in specific areas in the home (i.e., living room, stairs, bathroom, and bedroom). Hazards that were assessed included: lighting and furniture arrangement; presence of items that could cause a person to trip (i.e., unsecured throw rug and/or electrical cord); floor surfaces; bed height; and, handrails in the bathroom. All but one of the potential hazard items were assessed as: 0 = "no risk" or 1 = "has a risk." The one item not assessed as either 0 = "no risk" or 1 = "has a risk" was assessed from 0 = "no risk" to 4 = "has four risks". A total score, which could range from 0 to 31, was obtained by summing the response values across all items. A high score indicated the presence of numerous environmental hazards that could contribute to falls in the home. The reliability for the HEHQ, in this study, was 0.83. It took approximately10 minutes to complete the HEHQ.

Permission was obtained for use of all of the copyrighted instruments. Although the DDAFOQ, CMT, BBS, m-BADLI, CADLI, m-PRQ, and HEHQ were written in Thai, the CIRS-G was originally written in English and, thus, had to be translated and back translation to assure no changes in meaning occurred during the translation process. Translation of the instrument from English to Thai was performed by the PI, while the back translation from Thai to English was performed by two nursing faculty who were fluent in Thai and English.

In addition, prior to their use in the study, the content validity of each of the instruments was assessed by five field-related experts (one ophthalmic nurse, three gerontological nurse researchers, and one community gerontological nurse researcher). Based upon the experts' assessment, modifications were made to two of the items of the HEHQ in order to identify hazardous environments specific to visually impaired elders. The word 'sun light' was added to item one, while the words 'illumination lights both day and night' were added to item 15. After the modifications were made to the HEHQ, all of the instruments were pilot-tested on 30 older, visually-impaired Thais who were similar to the participants in the study. Based upon the results of the pilot test, no further changes were made in any of the instruments.

Procedure: The PI, after obtaining the names of potential subjects from the clinic nurses, informed the potential subjects about: the nature of the study; what their involvement would involve; the confidentiality and anonymity issues; and, their right to withdraw at any time without repercussions. Those who met the inclusion criteria, stated they understood the study's protocol, and agreed to participate in the study were asked to sign an informed consent prior to data collection. The PI then collected data, in a quiet area of each respective eye clinic, after the participants finished their physicians' appointments or while they were waiting to be seen by their physicians. Due to the presence of visual impairment or inability to read, the PI read the items in each questionnaire to the participants and recorded their verbal responses. A family member or caregiver was invited to attend the data collection session to help clarify, as needed, the participants' questions. The CMT was administered first to determine if the participants met the inclusion criteria for cognitive ability (score $\geq$ 15). Participants not meeting the cognitive inclusion criteria were thanked for their time and informed they did not meet the criteria for inclusion in the study. Participants who met the cognitive inclusion criteria then were administered the remaining questionnaires (i.e.: DDAFOQ; m-BADLI;[26] m-PRQ;[10, 28] CADLI; [26] CIRS-G;[39] and, HEHQ[30]) Upon completion of all of the questionnaires, the participants were assessed for visual acuity, visual contract sensitivity, depth perception, and physical performance involving balance using the: SNVC;[35, 36] FACT;[37] TFS;[38] and, BBS.[25]

Data Analysis: The participants' characteristics were analyzed via use of descriptive statistics (frequency, percentages, and mean), while the differences between the characteristics of older, visually impaired adults, who had fallen and those who had not fallen, were analyzed through use of Chi-square, univariate analysis, and analysis of variance. In addition, multiple logistic-regression analysis was performed to identify the significant fall risk factors.

Results

As shown in **Table 2**, participants who had experienced a fall over the past six months compared to participants who had not experienced a fall over the past six months demonstrated significantly lower scores in ADL, IADL, physical performance, and social support. No significant difference was found between the two groups regarding home environment hazards. The number of participants who had experienced comorbidities was not found to be different between the two groups (See **Table 3**). However, participants who had experienced a fall, compared to participants who had not experienced a fall, were found to have significantly higher comorbidity severity scores (See **Table 2**).

Table 2 Comparison of ADL, IADL, Physical Performance, Social Support, Home Environment Hazards, and Comorbidities between Participants Who Experienced a Fall and Those Who Did Not Experience a Fall

Variables	**No Falls n = 173**		**Falls n = 105**			
	Mean	SD	Mean	SD	*t*	*p*
ADL	18.92	1.96	17.86	2.45	3.774	.000**
IADL	6.60	1.96	5.69	2.06	3.669	.000**
Physical Performance	37.47	12.87	28.40	13.03	5.668	.000**
Social Support	113.92	10.59	109.97	11.14	2.954	.003**
Home Environment Hazards	7.46	2.06	7.43	2.59	.094	.925 ns
Comorbidity Severity	1.78	.58	1.91	.43	-2.049	.041*

Note: ADL = activities of daily living; IADL = instrumental activities of daily living; SD = standard deviation.

Table 3 Comparison of the Number of Participants with Comorbidities Who Experienced Falls and Participants Who Did Not Experience Falls

Variables	**No falls n = 173**		**Falls n = 105**				
	n	%	n	%	Total	χ^2	p
Comorbidities						3.647	.056 ns
No	15	83.3	3	16.7	18		
Yes	158	60.8	102	39.2	260		

As shown in **Table 4**, significant associations were found between the incidence of falls and ADL, IADL, physical performance, and social support. No significant associations were found between the incidence of falls and severity of visual acuity, depth perception, contrast sensitivity, comorbidity severity, and home environment hazards.

To examine the predictors of a fall occurrence (See **Table 5**), all independent factors were entered into the multiple logistic regression analysis. Only physical performance was found to be a significant predictor of incidence of falls. None of the other factors entered into the regression model. Thus, older Thai adults with visual impairment, who had poor physical performance, were significantly more likely to experience a fall compared to older Thai adults with visual impairment, who had good physical performance.

Table 4 Associations between Fall Incidences and Participants' Interpersonal, Intrapersonal, and Extra-personal Factors (n = 278)

Factors	B	Wald	OR	*p*	95%CI (lower-upper)
Visual Acuity		.926		.819	
at 20/70 -20/200	reference				
<20/200 to 20/400	.157	.272	1.170	.602	0.649-2.110
<20/400 to 5/300	.415	.592	1.515	.442	0.526-4.364
<5/300 to PL	-.144	.076	.866	.783	0.311-2.413
Depth Perception	.198	.564	1.219	.453	0.727-2.042
Contrast Sensitivity	.270	.622	1.310	.430	0.670-2.561
ADL	-.219	13.690	.803	.000	0.715-0.902
IADL	-.223	12.452	.800	.000	0.706-0.905
Physical Performance	-.140	16.125	.870	.000	0.812-0.931
Comorbidity Severity	.488	3.477	1.629	.062	0.975-2.720
Social Support	-.034	7.884	.967	.005	0.945-0.990
Home Environment Hazards	-.005	.010	.995	.920	0.894-1.107

Table 5 Predictors of Fall Incidences among Participants (n = 278)

Factors	*B*	Wald	*p*	Adjusted OR	95.0% Lower	CI for OR Upper
ADL	-.053	.472	.492	.948	.814	1.104
IADL	-.035	.151	.698	.966	.811	1.150
Social support	-.014	1.187	.276	.986	.961	1.011
Home environmental hazards	.060	1.002	.317	1.062	.944	1.196
Physical performance	-.041	9.373	.002	.959	.934	.985
Visual acuity		.481	.923			
at 6/18 to 6/60		--reference--				
<6/60 to 3/60	-.085	.059	.808	.918	.461	1.830
<3/60 to 1/60	.299	.245	.620	1.349	.413	4.411
< 1/60 to PL	-.180	.087	.768	.835	.253	2.758
Depth perception	.160	.276	.599	1.173	.647	2.128
Contrast sensitivity	-.172	.316	.574	.842	.463	1.532
Comorbidity severity	.125	.209	.647	1.133	.663	1.937
Constant	2.980	2.428	.119	19.681		
Hosmer & Lemeshow Goodness of Fit Test 14.166 (df = 8; p = 0.78 when p >.05)				-2 log likelihood = 334.407		
Cox & Snell R Square = 0.116 (peudo R square)				Nagelkerke R Square = .158		

Discussion

The prevalence of falls found, in this study, tended to be consistent with prior research.[9] However, the fall prevalence was higher, in this study, compared to studies done among elders, in general, who were living in a community.[23] It must be kept in mind that the participants, in this study, were visually impaired, older adults recruited from an eye clinic and not older adults, in general, recruited from a community setting.

Most participants (n = 183; 65.8 %) had moderate visual impairment (VA = 20/70-20/200) and at least one chronic illness (n = 260; 93.5%). Based on Neuman's Systems Model, the severity of visual impairment and the presence of comorbidity are intrapersonal factors that may reduce the afflicted individual's ability to respond to extra-personal factors (i.e., home environment hazards). As was found, in this study, the most common eye disorders that contributed to visual impairment were cataracts and glaucoma.[2]

Not unexpected, nearly all of the participants had comorbidities, with the most common being hypertension and type-II diabetes. These two chronic illnesses can contribute to the presence of visual impairment, in the form of degeneration of the eyes, as well as weakness of the muscles of the eye, which can lead to loss of peripheral vision.[41] Both hypertension and type-II diabetes, along with body degeneration due to aging, can significantly increase the likelihood of body instability while walking, which, subsequently, can cause an elder to lose his/her balance.[42]

The findings show that there was a significant difference in ADL, IADL, physical performance, social support, and comorbidity severity between the participants who had fall incidences and those who did not. Participants who had no incidences of falls had better ADL, IADL, physical performance, and social support than those who experienced incidences of falls. Not surprisingly, although there was no difference in the number of fall incidence between the participants who had experienced falls and those who had not, the participants who had experienced falls had higher comorbidity severity than the participants who had no fall incidences. The reason for these findings may have been due to the fact that as a decrease in ADL, IADL, physical performance, and social support, along with an increase in comorbidity severity, occurs, a decrease in physical strength to maintain balance, while performing physical functions,[10] is present which, in turn, increases the likelihood of the occurrence of a fall.[18]

The level of visual acuity, depth perception, and contrast sensitivity were not found to be associated with fall incidences. Most participants were found to have moderate to severe visual impairment (n = 245; 88%). As a result, the wide variability in visual impairment, in the sample, most likely helped to explain why no association was found between visual acuity and fall incidences. The fact that no association was found between fall incidence, and both depth perception and contrast sensitivity was similar to prior research.[9] However, it must be kept in mind that other studies used a variety of measures to assess visual impairment, which were not consistent with the measures used in this study. Thus, it is difficult to compare the results of this study with others studies.

Although the participants' capabilities in carrying out ADL and IADL were found to be associated with fall incidence, they were not found to be predictors of fall incidences. This finding was inconsistent with prior research that found poor performance in ADL and IADL were risk factors for falls.[18, 27] The participants, in this study, seemed to function independently because their ADL and IADL scores were high for both those who experienced falls and those who did not experience falls. The fact that ADL and IADL were not found to be predictors of fall incidence may have been due to the fact that they overlapped, to some degree, with physical performance, which was found to not only be associated with fall incidence, but also to be a predictor of fall incidence.

Generally, the presence of comorbidities is strongly associated with fall incidences, especially among visually impaired older adults.[22, 23] In this study, however, no association was found between comorbidities and fall incidence. The vast majority of study participants (n = 260; 93.5%) had comorbidities. The fact that the study sample was so homogeneous, making it difficult to determine the influence of comorbidities on fall incidences, may help explain why no significant association was found between comorbidities and fall incidences.

A significant association was found between social support and fall incidence. However, social support was not found to be a predictor of fall incidence. Prior research has found, among the elderly with visual impairments, an indirect association between social support and falls, through adaptation to visual loss.[29] This finding suggested that older adults, with visual impairments, can accept their impairments because they believe they have access to others (family/friends) to support them and provide them a safe environment. In this study, the social support scores were quite high among the participants. The lack of variability in social support scores may help to explain, why social support was found to be associated with fall incidence, but not found to be a predictor of fall incidence.

No significant association was found between home environment hazards and fall incidence. This finding was similar to prior research, in older adults, that reported no association between home environment hazards and falls.[32] However, it was different from prior research, conducted among older Thais, that found environment hazards of be factor associated with falls.[15]

Because the participants were from a metropolitan area, most of them had a comfortable area in which to live (i.e., accessible toilets, tidy homes, and appropriate lighting) that had few home environment hazards. Thus, there was little variability in the presence of home environment hazards, among the participants, making it difficult to demonstrate an association between home environment hazards and fall incidences.

Only physical performance was found to be a predicting factor of fall incidences. The fact physical performance was found to be a predictor of fall incidences was consistent with prior research.[23, 24] In addition, the fact that physical performance, but not visual factors, was found to predict fall incidence was similar to a study conducted in Australia.[9] The Australian study noted that visual factors were not significantly associated with fall incidences, among older individuals with low vision, but that physical inactivity was a factor. In addition, the Australian study found that physical inactivity, among visually impaired elders, tripled the likelihood of them experiencing fall incidences. The visual characteristics of participants in the Australian study were the same as the visual characteristics of the participants in this study. Thus, it appears that visual impairment may have less of an influence on fall incidences when individuals are able to adequately evaluate their environments and have the physical abilities (muscle strength, endurance, and good proprioception) to maintain body balance. The findings, of this study, suggested the importance of nurses, in an effort to prevent falls, assessing the physical performance of older, visually-impaired Thais.

Limitations and Recommendations

When applying the findings of this study, its limitations must be taken into consideration. The study involved only visually impaired elders who were being seen at one of three eye clinics in three different hospitals, in Bangkok. Thus, the findings are not generalizable to visually impaired elders who are not receiving healthcare at an eye clinic located in a hospital in a large metropolitan area. Future research needs to consider inclusion of participants from non-metropolitan areas and participants who may not be receiving medical care for their eyes.

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ปัจจัยที่เกี่ยวข้องกับการหกล้มในผู้สูงอายุไทยการมองเห็นบกพร่อง

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บทคัดย่อ: ปัจจัยเสี่ยงต่อการหกล้มในผู้สูงอายุ นั้นเกิดจากหลายปัจจัย การมองเห็นที่ลดลง การมีโรคเกี่ยวกับหัวใจหรือหลอดเลือด หรือโรคทางเมตาบอลิก ประกอบกับความแข็งแรงทางกายที่ลดลงของผู้สูงอายุ และการอยู่ในสิ่งแวดล้อมที่ไม่ปลอดภัย เหล่านี้เป็นเป็นที่ยอมรับกันว่าเป็นปัจจัยเสี่ยงที่สำคัญต่อการหกล้มในผู้สูงอายุ การศึกษาแบบตัดขวางนี้จุดประสงค์เพื่อทดสอบหาปัจจัยเสี่ยงต่อการหกล้มในผู้สูงอายุที่การมองเห็นบกพร่องได้แก่ปัจจัยการมองเห็นภาพชัดการมองเห็นสามมิติความคมชัดของการมองเห็นในการจำแนกวัตถุออกจากพื้นหลังความสามารถในการปฏิบัติกิจกรรมประจำวันความสามารถในการปฏิบัติกิจกรรมประจำวันแบบต่อเนื่องความสามารถในการทำกิจกรรมการเคลื่อนไหวร่างกายความเจ็บป่วยเรื้อรังการสนับสนุนทางสังคมและสิ่งแวดล้อมในบ้านที่เป็นอันตรายต่อการเกิดการหกล้ม กลุ่มตัวอย่างคือผู้สูงอายุการมองเห็นบกพร่องที่มีอายุตั้งแต่ 60 ปีขึ้นไปจำนวน 278 คนที่อาศัยอยู่ในกรุงเทพมหานครมารับการตรวจรักษาในโรงพยาบาลตติยภูมิข้อมูลที่ได้เก็บโดยการสัมภาษณ์จากแบบสอบถามและการตรวจประเมินทางร่างกายสถิติที่ใช้ในการวิเคราะห์ข้อมูลคือ Multiple logistic regression

อุบัติการณ์การหกล้มตั้งแต่หนึ่งครั้งใน 6 เดือนก่อนของผู้สูงอายุที่มีการมองเห็นบกพร่องคิดเป็นร้อยละ 37.8 กลุ่มตัวอย่างส่วนใหญ่ (ร้อยละ 65.8) การมองเห็นบกพร่องอยู่ในระดับปานกลาง (VA of 20/70–20/200) ซึ่งมีสาเหตุมาจากโรคต้อกระจกมากที่สุด(ร้อยละ 37.8) ตามด้วยโรคต้อหิน (ร้อยละ 28.8) เมื่อวิเคราะห์ multiple logistic regressionพบว่ามีเพียงปัจจัยความสามารถในการทำกิจกรรมการเคลื่อนไหวร่างกายที่สามารถทำนายการเกิดการหกล้มได้ที่ระดับนัยสำคัญทางสถิติที่ $p < .001$ (adjusted OR = .959, CI: .934-.985) ผู้สูงอายุการมองเห็นบกพร่องที่มีความสามารถในการทำกิจกรรมการเคลื่อนไหวร่างกายไม่ดีมีความเสี่ยงต่อการเกิดการหกล้ม ดังนั้นสิ่งสำคัญเพื่อป้องกันการหกล้มพยาบาลควรประเมินหาปัจจัยเสี่ยงความสามารถในการทำกิจกรรมการเคลื่อนไหวร่างกายนี้ในผู้สูงอายุไทยที่การมองเห็นบกพร่อง

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คำสำคัญ: การหกล้ม ผู้สูงอายุไทย การมองเห็นบกพร่อง ความเจ็บป่วยเรื้อรัง ความสามารถในการทำกิจกรรมการเคลื่อนไหวร่างกาย

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