Risk Factors for Falls in the Thai Elderly in an Urban Community

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Abstract

Background : Instability or falls in the elderly are a health condition meeting all criteria for prevention i.e. high frequency, evidence of preventability and a high burden of morbidity. The consequences of a fall affect not only the elderly per se such as fractures and various kinds of physical and mental impairment, but also the family and the society as a whole in terms of the financial expenditure involved. The need for a comprehensive study to identify the risk factors for falls among the Thai elderly is, therefore, crucial for further management.

Objective : To identify the significant risk factors for falls among the Thai elderly for further prevention and management.

Method : A cross-sectional study in the urban community around Siriraj Hospital, Bangkok. 1,043 community-dwelling people aged ≥ 60 years were recruited. A structured questionnaire, including mental test and physical examinations as well as various laboratory tests, were used to identify the risk factors for falls between faller and control groups.

Results : The overall prevalence of falls among elderly Thais in an urban area was 19.8 per cent during a period of 6 months. However, the prevalence was 24.1 per cent in women but only 12.1 per cent in men. Older people who were likely to fall also had a lower bone mass which predisposed them to future fractures. The independent risk factors for falls after multiple logistic regression analysis were : female gender, hypertension, deafness, poor memory, poor self-perceived health status, poor performance in the instrumental activities of daily living, kyphoscoliosis, use of spectacles, rapid pulse rate after a 5 minute rest, higher serum transferrin and poor nutrition in terms of low lean body mass and reduced serum albumin level.

Conclusions : Special sense, activity of daily living, nutritional status, kyphoscoliosis, hypertension and cognitive ability were six important factors determining the likelihood of fall among the elderly in an urban area.

Key word : Fall, Risk Factors, Urban, Elderly

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Instability and falls are common nonspecific symptoms among elderly people both in the community and institutions as shown by a prevalence of 35-45 per cent of those who presented to the accident and emergency department of Thailand's local hospitals[1,2]. The crucial issue is not the wide range of outcomes including the physical and mental injuries sustained by the elderly people themselves, or the socioeconomic burdens to the relatives and society as a whole, but the underlying intrinsic multiple pathology hidden in the victim which sequentially leads to injury and premature death if undetected. Although more than 130 risk factors for falls has been identified[3], the difference in health and socioeconomic background of elderly people in each culture suggests there may be a difference in the most important risk factors in each country. Although falls have been described in the rural areas of Thailand[4], a comprehensive investigation involving the medical background; a physical and mental examination; extensive laboratory tests including the nutritional status; and bone mineral density to determine the underlying fragility of the skeletal system; have not been conducted previously in Thailand. The main objective of this present investigation was therefore to determine the various common intrinsic risk factors for falls in the urban area around Siriraj Hospital Medical School.

SUBJECTS AND METHOD

Subjects

1,043 elderly subjects aged 60 years or more from 12 local communities around Siriraj Hospital were recruited by random sampling from the name lists of the community. The fall group included those who had fallen within the previous 6 months i.e. lost their balance resulting in any part of their body hitting the ground. All were interviewed by trained nurses using a structured questionnaire that contained questions concerning their general health background; a history of falls and related events; any physical and mental complaints; and their activities of daily living. All were examined by the author team looking for any abnormality and particularly in the cardiovascular, neurological and musculo-skeletal systems. The use of any medical appliances (viz. a walking stick, spectacles, dentures, a walking frame, or urinary catheter) was also recorded. All participants gave informed consent and the Siriraj Hospital Research Ethics Committee approved the study.

Instruments

The activities of daily living designed by the Survey in Europe on Nutrition and the Elderly, A Concerted Action (SENECA) was used[5]. This structured test can be divided into two aspects of activities of daily living namely mobility index (MI) and self-care index (SI). The Thai Mental State Exam (TMSE), a screening tool for the mental health of the Thai older people, was also employed[6]. Self-perceived health was surveyed by the question "If you compare your health with that of other persons you know of your age, is your own health worse, about the same, or better?" The choices of answer consist of "worse", "about the same", "better" and "don't know"[7]. Visual acuity was assessed by Snellen chart and a portable screening audiometer (Welch Allyn Audioscope 3™) was used to test for hearing difficulty. Those who did not hear a sound at 40 dB at any of the following frequencies 500, 1,000, 2,000 and 4,000 Hz by both ears were labeled as hearing impaired. Biochemical tests used included blood glucose, lipid profile, albumin, calcium and transferrin as well as a complete blood count. The body composition of the subjects was also measured using the technique of near-infrared interactance[8], Futrex-5,000/XL™. Finally, ultrasound bone densitometry (Archilles Plus™) was used to assess the bone mass of the subjects.

Statistical analysis

The Chi-square test was used to determine differences in various dichotomous variables between subjects who had a history of fall and those who did not. Likewise, the Student *t*-test was used to investigate any difference in quantitative variables between the two groups. The two-tail Fisher's exact test was also employed in cases where the minimum expected frequency was less than 5. Finally, following univariate analysis the significant risk factors which were able to independently determine the history of fall were analyzed by multiple logistic regression analysis.

RESULTS

The average age of the 371 men was 66.8 years (± 5.5) while that of the 672 women was 67.7 years (± 6.7). The prevalence of falls within the previous 6 months was 12.1 per cent and 24.1 per cent among men and women respectively with an overall prevalence of 19.8 per cent (95% CI: 17.5-22.4). The

significant personal characteristics and medical histories, which were found to be more prevalent within the fall group compared with the control group, are shown in Table 1. Some of the variables which did not reveal any significant difference between the two groups and hence are not shown in the table were: a slippery floor in the living area ($p = 0.10$), current alcohol intake ($p = 0.24$), a history of heart disease ($p = 0.45$), lung disease ($p = 0.53$), joint disease ($p = 0.13$) and diabetes mellitus ($p = 0.29$). Hypertension was the only underlying chronic medical problem found more frequently among the fall group. However, the fall group experienced many more current complaints. These included: visual impairment, hearing difficulty, sleeping difficulty, and memory impairment. Interestingly, complaints of dizziness did not achieve as significant a difference as other symptoms ($p = 0.08$). As expected, a history of antihypertensive therapy was the only drug history significantly related to the fall group. Specific drug histories which did not reveal any relationship with the fall group were treatment with: psychoactive ($p = 0.27$), cardiovascular ($p = 0.43$), antiepileptic ($p=0.15$), and a traditional herbal pill ($p = 0.70$).

Each item of daily living activities was measured on a 4-point scale namely: being unable to do the activity completely (4 points); can do only with help (3 points); can do with difficulty but without help (2 points); and, can do without difficulty (1 point). All 16 items revealed a statistically significant impairment of the fall group compared with the control group ($p < 0.001$ except for going outdoors $p < 0.02$). When the walking ability of the subjects (called here the mobility index, range 4-16) was considered the sum of the following 4 items namely going outdoors, using stairs, walking at least 400 metres, carrying a heavy object for at least 100 metres, was significantly worse within the fall group ($p < 0.001$) as shown in Table 3. Similarly, the self-care index (range 7-28) also revealed worse performance among the fall group ($p < 0.001$) when the following items were added together: walking between rooms, toilet use, grooming and bathing, dressing, getting in and out of bed, cutting toe-nails, and eating, as is shown in Table 3. The other five items of the test (i.e. ability to use the telephone, take own medication, manage finances, do light housework, and do heavy housework) could be summed up as another indicator called instru-

Table 1. Comparison of personal characteristics and medical history between the fall and the control group.

	Faller*	%	Control*	%	P-value	Odds ratio	95% CI
Female gender	162	78.3	510	61.0	< 0.0001	2.3	1.59-3.35
Age ≥ 80 years old	21	10.1	45	5.4	< 0.02	1.98	1.11-3.52
No or little exercise during the last year	112	56.3	380	47.1	< 0.03	1.44	1.04-2.00
Presence of chronic illness	196	94.7	732	87.9	< 0.01	2.46	1.25-4.94
Hypertension	87	42.0	233	28.0	< 0.001	1.87	1.35-2.59
Impaired vision	120	58.0	375	45.0	0.001	1.68	1.22-2.32
Hearing difficulty	56	27.1	132	15.8	0.0003	1.97	1.35-2.86
Insomnia	71	34.3	194	23.3	0.002	1.72	1.22-2.42
Impaired memory	84	40.6	179	21.5	< 0.0001	2.50	1.78-3.49
Hypotensive therapy	59	28.6	172	20.8	0.02	1.52	1.06-2.18

* indicates the percentage of subjects with the problem out of the overall cases for each group.

Table 2. Comparison of physical examination results between the fall and the control groups.

	Faller*	%	Control*	%	P-value	Odds ratio	95% CI
Abnormal gait	40	20.3	81	10.0	< 0.001	2.28	1.47-3.53
Ataxia	8	4.1	10	1.2	0.01	3.37	1.2-9.4
Use of walking stick	21	10.2	37	4.5	< 0.003	1.91	1.32-2.75
Visual acuity ≤ 6/24	59	39.9	187	27.0	0.002	1.6	1.2-2.15
Use of spectacles	120	58.5	586	71.2	< 0.001	0.64	0.5-0.82
Musculoskeletal deformity	42	21.0	86	10.7	< 0.001	1.82	1.37-2.42
Kyphoscoliosis	26	13.1	41	5.1	< 0.001	2.1	1.51-2.92

* indicates the percentage of subjects with the problem out of the overall cases for each group.

mental activities of daily living (range 5-20). Such instrumental activities of daily living were also significantly worse in the fall group ($p < 0.001$). Assessing self-perceived health found the answers to be significantly worse in the fall group ($p < 0.0001$).

As far as the underlying nutritional status was concerned, neither actual body weight nor body mass index showed any difference between the two groups. However, the body composition analysis showed that the fall group had a greater percentage of body fat ($p = 0.004$) but less lean body mass ($p < 0.02$) and less total body water ($p < 0.03$) compared with the control group. Serum transferrin, which can be a more sensitive measure of current nutritional status than serum albumin, as it falls more rapidly during under-nutrition, was significantly higher than the control group ($p = 0.02$). Measurement of bone density by ultrasound showed that the fall group had lower bone stiffness as well as a lower percentage of bone stiffness compared with young adults (T-score) and their counterparts of the same age (Z-score). This finding indicates that an older person who is likely to fall also has a lower bone mass and both factors predispose them to future fracture.

After multiple logistic regression analysis, the independent risk factors which are able to predict the occurrence of fall can be listed in order of their power of prediction as follows: female gender (OR = 2.3; 95% CI: 1.59-3.35); kyphoscoliosis (OR = 2.35; 95% CI: 1.27-4.34); low serum albumin (OR = 1.86; 95% CI: 1.17-2.96); memory impairment (OR = 1.85; 95% CI: 1.25-2.73); hypertension (OR = 1.59; 95% CI: 1.1-2.3); deafness (OR = 1.58; 95% CI: 1.03-2.43); use of spectacles (OR = 0.63; 95% CI: 0.44-0.92); poor self-perceived health status (OR = 1.49; 95% CI: 1.04-2.14); high serum transferrin (OR = 0.82; 95% CI: 0.69-0.98); poor performance in the instrumental activities of daily living (OR = 0.91;

Table 3. Comparison of quantitative data for vision, nutritional status, bone mineral density, pulse rate and blood pressure between fallers and controls.

	Faller	Control	P-value
Age	68.9 ± 7.2	67.4 ± 6.1	0.005
Thai mental state exam score	21.6 ± 5.6	22.5 ± 5.2	< 0.03
Mobility index	6.4 ± 2.9	5.5 ± 2.4	< 0.001
Self-care index	8.3 ± 2.9	7.6 ± 1.7	< 0.001
Instrumental activity of daily living	7.0 ± 2.9	6.0 ± 2.2	< 0.001
Total activity of daily living	21.7 ± 7.7	19.0 ± 5.7	< 0.001
Height (cm)	152.6 ± 8.1	154.9 ± 7.9	< 0.001
Per cent body fat (%)	41.0 ± 6.7	39.5 ± 7.6	0.004
Lean body mass (kg)	33.9 ± 7.3	35.3 ± 7.5	< 0.02
Total body water (kg)	26.6 ± 5.5	27.6 ± 5.5	< 0.03
Per cent total body water (%)	46.3 ± 4.4	47.3 ± 5.0	< 0.01
Bone stiffness by ultrasound bone density	59.5 ± 18.8	64.6 ± 17.5	< 0.001
% young adult (T-score)	62.7 ± 18.6	66.6 ± 16.5	< 0.01
% age-matched (Z-score)	82.7 ± 23.5	87.0 ± 21.2	< 0.02
Diastolic blood pressure after 5 min sitting (mmHg)	82.9 ± 15.4	80.6 ± 14.5	< 0.05
Pulse after 5 min sitting (per minute)	81.4 ± 13.6	79.2 ± 13.3	< 0.05
Systolic blood pressure after 1 min standing (mmHg)	145.1 ± 29.9	140.1 ± 27.6	< 0.03

Table 4. Comparison of hematological and biochemical blood tests between the fallers and controls.

	Fallers	Control	P-value
Hemoglobin (g/dl)	13.0 ± 1.6	13.4 ± 1.7	< 0.01
Platelet Count (cells/mm^3)	270.4 ± 78.4	250.5 ± 75.3	0.001
Transferrin (g/l)	2.95 ± 1.05	2.75 ± 0.92	0.02
Albumin (g/dl)	4.96 ± 0.39	5.02 ± 0.40	< 0.05
Calcium (mEq/l)	10.22 ± 0.75	10.36 ± 0.83	< 0.03

95% CI: 0.85-0.98); low lean body mass (OR = 0.96; 95% CI: 0.92-0.98); and rapid pulse rate after 5 minutes rest (OR = 0.98; 95% CI: 0.97-0.99).

DISCUSSION

The overall prevalence of falls over the previous 6 months was 19.8 per cent (95% CI: 17.5-22.4) which is in agreement with the national survey in Thai rural areas where the figure was 18.7 per cent (4). This finding implies no geographical difference in terms of fall risk between the elderly who live in urban and rural areas. Compared with the prevalence among Western elderly, Oboler et al reported annual figures of 201-291 cases and 335-402 cases per 1,000 male and female older population respectively(9). This data also agrees with the presented figures of 242 cases and 482 cases per 1000 men and women respectively. We are led to believe that worldwide older women suffer from falls about twice as frequently as do older men.

Speechley et al suggested that the risk of falls continues to increase among active healthy elderly people much more than those who are frail and who spend most of the time lying in bed(10). If this is correct the identification of risk factors for falls among those who look fit and maintain their activities of daily living in the community has a higher priority for further attempts at prevention. The twelve independent risk factors for falls detected by the present study can be grouped into six main problems namely: kyphoscoliosis, nutritional status (including low serum albumin and lean body mass), cognitive problems, hypertension, impaired special sense function (e.g. impaired vision and/or hearing), and poor performance in instrumental activities of daily living. Despite the fact that poor self-perceived health was found to be an independent risk factor for falls, it may be a sequel of falls rather than the cause of falls. Female gender was found as the most important unpreventable risk factor for falls, as it achieved the highest odds ratio in the multiple logistic regression analysis. This suggests that the older women should receive greater priority in any preventive programme and particularly since it is known that the prevalence of fracture of the neck of femur is 2.23 times more common among older Thai women than older Thai men(11).

Osteoporosis of the vertebrae commonly causes kyphoscoliosis which the authors found to be the second most important risk factor for falls. A fall may result in the fracture of vertebrae and decreased height ($p < 0.001$ as shown in Table 3) and cause or aggravate deformity. Interestingly, bone densitometry measured by ultrasound revealed that, regardless of the presence of fracture, the fall group had a significantly lower bone mass compared with the control group. The univariate analysis of bone stiffness, the percentage of bone stiffness compared with young adults, and the percentage of bone stiffness compared with an age matched group showed statistically significant differences at $p < 0.001$, $p < 0.01$ and $p < 0.02$ respectively. These findings are supported by the report that the prevalence of osteoporosis in older people who suffered from a fall with fracture of the hip joint and a fall without fracture were 87 per cent and 62 per cent respectively(12).

As far as nutritional status is concerned, the fall group had a lower serum albumin and lean body mass. This reflects the importance of an individual's muscle mass and their power to control posture and thus prevent falls. It has been shown that weak quadriceps and postural sway can discriminate for those people with a tendency to fall from those less likely to fall in up to 92 per cent of cases with equal sensitivity and specificity(13). Obesity appears to be an additional factor since the fall group had a higher per cent of body fat than the control group ($p = 0.004$). Older women have a tendency to a higher percentage of body fat and a more bulky body build than older men. This may explain the increased likelihood of falls among older women and the reason why percentage of body fat was not selected by multiple logistic regression analysis(14). Moreover, the hemoglobin level, an indirect indicator of nutritional status, was also lower in the fall group ($p < 0.01$). It is well known that anemia is an important predisposing factor for postural syncope, which in turn may lead to a fall(15). Serum transferrin was unexpectedly higher among the fall group, in fact it could be expected to be lower during undernutrition, suggesting the existence of other confounding factors such as chronic infection, trauma, and liver disease resulting in a higher level of serum transferrin among the fallers(16).

Cognitive impairment is another factor found as an important risk for a fall(15-17). Both the Thai Mental State Exam Score or the complaint of memory impairment were significantly different between the two groups ($p < 0.03$ and < 0.0001 respectively). This usually reflects global impairment of cerebral function and gait control is therefore inevitably affected.

The other common chronic medical condition leading to a fall among the elderly is hypertension (OR = 1.59). The reason behind this finding may include many factors, one of which is the poor heart rate response on standing leading to postural hypotension with hypertension[18]. Likewise, the finding of a higher pulse rate after 5 minutes rest (OR = 0.98; 95% CI: 0.97-0.99) among the fall group could additionally indicate the effects of poor physical fitness upon the heart rate response following postural change[19].

Without doubt the visual acuity was found to be worse among the fall group (p = 0.001) as well as the more common complaint of vision problems (OR = 1.68). Screening for and correction of vision impairment is therefore essential for fall prevention. The symptom of deafness was also seen as contributing to increase the likelihood of falling in frail older people especially when occurring in conjunction with other sensory deficits to produce a multiple sensory deficit syndrome resulting in impaired environmental awareness[20].

Regarding the activities of daily living, the risk of falling has been predicted by using the Modified Gait Abnormality Rating Scale (GARS-M) in community studies and the Physical Performance Test (PPT)[21], in hospital inpatients by the St Thomas's risk assessment tool (STRATIFY)[22]. The present results show that the 5-item instrumental activities of daily living scale, which is more compact than the full activities of daily living scale, can be a better screening tool for fall risk in the community.

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ปัจจัยเสี่ยงต่อภาวะหกล้มในผู้สูงอายุไทยในชุมชนเมือง

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ภาวะหกล้มในผู้สูงอายุเป็นพยาธิภาวะที่สมควรได้รับการป้องกันอย่างรีบด่วนเนื่องจากอุบัติการณ์ของภาวะนี้ที่พบมากขึ้นตามลักษณะโครงสร้างประชากรไทยที่มีสัดส่วนผู้สูงอายุเพิ่มขึ้นอย่างรวดเร็ว ยังนำมาซึ่งกระดูกหัก ความเจ็บป่วยทั้งทางกายและจิต ความพิการทุพพลภาพ และความสูญเสียทางเศรษฐกิจทั้งต่อครอบครัวและสังคมโดยรวม การศึกษาปัจจัยเสี่ยงเพื่อนำมาสู่แนวทางการป้องกันจึงมีความจำเป็น การศึกษาแบบภาคตัดขวางเพื่อหาความชุกและปัจจัยเสี่ยงของการหกล้มครั้งนี้ ใช้การซักประวัติ ตรวจร่างกายและการตรวจทางห้องปฏิบัติการที่เกี่ยวข้อง ได้รวบรวมผู้สูงอายุ 1,043 รายที่อาศัยอยู่ในชุมชนรอบโรงพยาบาลศิริราช พบว่าความชุกของการหกล้มในระยะหกเดือนก่อนการศึกษาเท่ากับร้อยละ 24.1 ในหญิง และร้อยละ 12.1 ในชาย หรือคิดเป็นร้อยละ 19.8 ของประชากรตัวอย่างทั้งหมด ผู้สูงอายุที่มีความเสี่ยงจะหกล้มมักมีความหนาแน่นของกระดูกน้อยกว่าผู้สูงอายุทั่วไปทำให้เพิ่มความเสี่ยงต่อภาวะกระดูกหัก ปัจจัยเสี่ยงอิสระต่อการเกิดภาวะหกล้มได้แก่ เพศหญิง โรคความดันโลหิตสูง อาการหูตึง อาการหลงลืมสับสน ความรู้สึกต่อสุขภาพของตนเองด้อยกว่าผู้อื่นในวัยเดียวกัน ความสามารถในการดำเนินกิจวัตรประจำวันที่ลดลง กระดูกสันหลังโก่ง การใช้แว่นสายตา ชีพจรหลังจากนั่งพักห้านาทีที่เร็ว ภาวะทุโภชนาการในลักษณะลดลงของมวลเนื้อเยื่อที่ไม่ใช่ไขมันและระดับอัลบูมินในเลือด กล่าวโดยสรุป ปัจจัยเสี่ยงที่มีผลต่อภาวะหกล้มของผู้สูงอายุในชุมชนเมืองอาจรวมเป็นหกกลุ่มปัญหาได้แก่ ประสาทสัมผัสพิเศษที่เสื่อมลง ภาวะทุโภชนาการ ความสามารถในการดำเนินกิจวัตรประจำวัน กระดูกสันหลังโก่ง ภาวะความดันโลหิตสูงและปัญหาความจำ

คำสำคัญ : หกล้ม, ปัจจัยเสี่ยง, ชุมชนเมือง, ผู้สูงอายุ

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