Risk Factors of Pressure Ulcers in Hospitalized Elderly*

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Abstract : **This study is a hospital based concurrent cohort study with the objectives of investigating the risk factors and the predictive level of the risk factors of pressure ulcers in hospitalized elderly. The study was conducted between January 9th and March 12th 2002, in the medical, surgical, and orthopedic wards of Pranangklao Hospital, a 430-bed tertiary hospital under the Ministry of Public Health in Nonthaburi Province. The participants in this study were 117 hospitalized elderly patients who were 60 years or older, did not have pressure ulcers on admission, and were hospitalized for at least four days. Data were collected by the researcher and the research assistant who achieved an inter-rater reliability for pressure ulcer risk assessment and skin assessment on the research instrument of 0.905 and 0.954 respectively. Pressure ulcer risk assessment and skin assessment were conducted daily by utilizing the Braden pressure ulcer risk assessment scale and the Bergstrom's skin assessment scale throughout the study period. Logistic regression analysis was employed to analyze the data. The results of the study revealed the greatest frequency of pressure ulcers was found in those aged 70 to 79 years old (41%) and had neurological or spinal problems (30.8%). The assessment of elderly patients' risk of pressure ulcers on admission correctly predicted 71.8% of pressure ulcers. Of the elderly patients who were predicted to have pressure ulcers, 28.2% developed this complication during the hospitalization period. Most pressure ulcers occurred on the second day after admission. Of the elderly who were predicted not to develop this complication, 93.6% were free from pressure ulcers. An increase in friction and shearing (OR = 4.592, 95% CI = 1.531-13.770) was the risk factor that had the most influence among the participants, where the second most important risk factor was an increase in core temperature (OR = 2.760, 95% CI = 1.105-6.891). This study indicates the need for pressure ulcer risk assessment at the time of admission and a need for a pressure ulcer education program for the elderly or their caregivers and for all health care providers. In addition, this study also reveals the need for proper management of these elderly patients who are prone to develop pressure ulcers at the time of admission, especially among those who have increases in friction and shearing forces and an increase in core temperature.**

Key words : Risk factors, Pressure ulcers, Elderly

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เรื่องย่อ : **ปัจจัยเสี่ยงในการเกิดแผลกดทับในผู้สูงอายุที่รับไว้ในโรงพยาบาล***

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การศึกษาครั้งนี้เป็นการศึกษาแบบติดตามผลไปข้างหน้าจากข้อมูลพื้นฐานภายในโรงพยาบาล เพื่อค้นหาปัจจัยเสี่ยงและปัจจัยทำนายการเกิดแผลกดทับในกลุ่มผู้สูงอายุที่รับไว้ในโรงพยาบาล ระยะเวลาในการศึกษาระหว่างวันที่ 9 มกราคม 2545 ถึงวันที่ 12 มีนาคม 2545 ณ หอผู้ป่วยสามัญ ภายในโรงพยาบาลพระนั่งเกล้า ซึ่งเป็นโรงพยาบาลระดับตติยภูมิ ขนาด 430 เตียง สังกัดกระทรวงสาธารณสุข โดยทำการศึกษาในผู้สูงอายุที่มีอายุตั้งแต่ 60 ปีขึ้นไป รับไว้ในโรงพยาบาลไม่เกิน 24 ชั่วโมง ไม่มีแผลกดทับเมื่อแรกรับเข้าไว้ในโรงพยาบาล และมีระยะเวลาพักรักษาในโรงพยาบาลตั้งแต่ 4 วันขึ้นไป จำนวน 117 ราย เก็บรวบรวมข้อมูลโดยผู้วิจัยและผู้ช่วยวิจัย ซึ่งมีความเท่าเทียมกันในการประเมินความเสี่ยงในการเกิดแผลกดทับตามเครื่องมือในการศึกษาจากค่าสัมประสิทธิ์ แคปปา .905 ($p < 0.001$) และความเท่าเทียมกันในการประเมินสภาพผิวหนังจากค่าสัมประสิทธิ์แคปปา .954 ($p < 0.001$) ประเมินความเสี่ยงในการเกิดแผลกดทับจากปัจจัยเสี่ยง 8 ชนิด คือ อายุ อุณหภูมิ และปัจจัยเสี่ยงในแบบประเมินความเสี่ยงในการเกิดแผลกดทับของบราเดน ประกอบด้วย การรับรู้ความรู้สึก การปฏิบัติกิจกรรม การเคลื่อนไหว ภาวะโภชนาการ ความชื้น และแรงเสียดสีและแรงเฉือน นับตั้งแต่รับไว้ในโรงพยาบาลและทุกวันตลอดระยะเวลาที่รับไว้ในการศึกษา ร่วมกับการประเมินสภาพผิวหนัง ใช้สถิติวิเคราะห์การถดถอยพหุคูณแบบลอจิสติคในการวิเคราะห์ข้อมูล ผลการศึกษาในครั้งนี้พบว่าผู้ที่เกิดแผลกดทับส่วนใหญ่มีอายุระหว่าง 70 ถึง 79 ปี (41%) และเจ็บป่วยด้วยโรคทางระบบสมองและไขสันหลัง (30.8%) การประเมินความเสี่ยงในการเกิดแผลกดทับตั้งแต่แรกรับทำนายการเกิดแผลกดทับในผู้สูงอายุที่รับไว้ในโรงพยาบาลได้ 71.8% ผู้ป่วยที่ทำนายว่าจะเกิดแผลกดทับเกิดแผลกดทับจริง 28.2% โดยส่วนใหญ่เกิดแผลกดทับในวันที่ 2 ภายหลังเข้ารักษาตัวในโรงพยาบาล สำหรับผู้ป่วยที่ทำนายว่าจะไม่เกิดแผลกดทับไม่เกิดแผลกดทับตามที่ทำนาย 93.6% ปัจจัยเสี่ยงที่ทำนายการเกิดแผลกดทับได้สูงสุดคือ การเพิ่มขึ้นของแรงเสียดสีและแรงเฉือน (OR = 4.592, 95%CI = 1.531-13.770) ในขณะที่การเพิ่มขึ้นของอุณหภูมิสามารถทำนายการเกิดแผลกดทับได้เป็นอันดับที่ 2 (OR = 2.760, 95%CI = 1.105-6.891) การศึกษานี้ชี้ให้เห็นความต้องการการประเมินความเสี่ยงในการเกิดแผลกดทับในผู้สูงอายุนับตั้งแต่วันแรกที่รับไว้ในโรงพยาบาล และความต้องการในการจัดโครงการสอนสุขศึกษาในเรื่องเกี่ยวกับแผลกดทับให้แก่ผู้สูงอายุและญาติ รวมทั้งเจ้าหน้าที่ในทีมสุขภาพ ตลอดจน

การบริหารจัดการที่เหมาะสมสำหรับผู้สูงอายุที่มีความเสี่ยงในการเกิดแผลกดทับ โดยเฉพาะอย่างยิ่งในรายที่มีการเพิ่มขึ้นของแรงเสียดสีและแรงเฉือนและการเพิ่มขึ้นของอุณหภูมินับตั้งแต่รับไว้ในโรงพยาบาล

Background and Significance of the Study

Pressure ulcers are one of the important complications that often occur among hospitalized elderly population.[1-3] They absorb a large amount of time and money for these patients and their families, and the problem is nation-wide.[2,4-5] As elderly Thai population increases, the number of elderly patients with chronic illness and disabilities also increases.[6] This is reflected by the increasing proportion of hospitalized elderly patients and their length of hospitalization. At Pranangklao Hospital, a tertiary care 430 bed hospital in Nonthaburi Province, the medical statistics showed that the proportion of inpatient elderly had increased from 12.3% in the year 2000 to 21.3% in the year 2001.

The occurrence of pressure ulcers among hospitalized elderly is higher than the occurrences among younger patients. A report[1] found the occurrence of pressure ulcers in patients with chronic illness who were 60 years old or over and had been admitted to medical wards at Ramathibodi Hospital was 6.99% or 0.7 times higher than that of the younger patients. The incidence of pressure ulcers in the immobilized elderly in medical wards of Siriraj Hospital[3] was 24% or 1.5 times higher than in the younger patients. This may be the result of chronic diseases and their complications, which are threatening the elderly, mainly by decreasing their mobility and activities.[2-3,7-9,10-12]

The higher incidence of pressure ulcers in the elderly is probably the result of physiological changes.[13] These changes make them prone to pressure,[14] and friction and shearing forces.[9] Poor nutritional status, which is normally found among the hospitalized elderly also affects skin integrity and wound healing mechanisms.[15] As a result, it may lead to the risk of pressure ulcer development among the hospitalized elderly population.[9] Other factors, which induce pressure ulcers in the elderly include decreases in activities and mobility. Several studies found that the elderly who have paralysis, heart disease, respiratory disease, or cancer[16] are prone to these two factors. An increase in body temperature due to their illness, because of inflammation or infectious diseases, is also a factor that can cause pressure ulcers.[17] In addition, decreases in activities and mobility produce a higher rate of tissue metabolism and induce tissue hypoxia, especially in the skin and muscles.[18]

Pressure ulcers have a negative result on an elderly patient's health, and the expense of pressure ulcer treatment is relatively high. A study by Burd and others[19] found that the death rate in the elderly who developed pressure ulcers was 4-6 times higher than those who did not. Allman and others[5] reported that the infection rate and complications were 25.8% higher in those who developed pressure ulcers than those who did not. The common areas for pressure ulcers are the coccyx and the sacral region.[9,20] This may result in higher proportions of infection and pain in those who have pressure ulcers compared with those who do not. Tamnanthong & Kosuwan[4] reported that the cost of pressure ulcer treatment in patients who had pressure ulcers in a rehabilitation unit in Songkhlanakarin Hospital reached 47,764.70 ± 54,988.16 Baht for each patient. Because of these high costs, the patients could not fully reimburse this cost under any financial schema. More than half of this payment was supported by the hospital budget. This has a considerable negative impact on the national economy.

Because of the impact of pressure ulcers in the hospitalized elderly, it is necessary to search for effective strategies for pressure ulcer prevention in this group of patients. In Thailand, from the year 1983 to 2001, there have been only 13 studies regarding pressure ulcers; these studies included research articles, thematic papers, and thesis papers. However, none of these reports specifically studied pressure ulcers in the hospitalized elderly. Existing knowledge from various literature has demonstrated that knowledge of pressure ulcer risk factors is significant information that can provide health care personnel with accurate knowledge to prevent pres-

sure ulcers. Therefore, it is very important to conduct an epidemiological study to explore the risk factors of pressure ulcers among the hospitalized elderly and to determine the predictive value of these factors.

Purposes of the Study

1. To study the risk factors for pressure ulcers among the hospitalized elderly.
2. To study the predictive value of the risk factors for pressure ulcers among the hospitalized elderly.

Conceptual Framework

The conceptual framework of this study was adapted from a conceptual schema for the study of the etiology of pressure sores as developed by Barbara Braden and Nancy Bergstrom in1987 (Figure 1). Because of its clarity, this conceptual schema is most frequently cited as a conceptual framework in previous pressure ulcer studies.[3,10,21] Based on Braden and Bergstrom's conceptual schema, the occurrence of pressure ulcers among the elderly individuals can be elaborated as follows:-

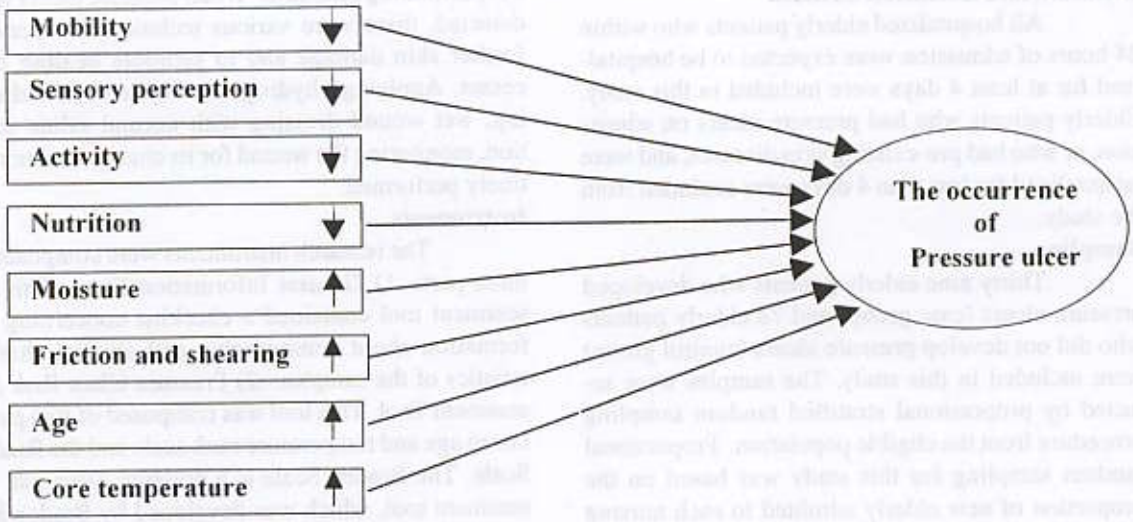


Figure 1. The conceptual framework for the study of risk factors of pressure ulcers in hospitalized elderly.

The precise determinations of pressure ulcers are, firstly, the intensity and the duration of pressure. A pressure intensity of more than 32 mmHg produces obstruction to the blood supply, causing skin and tissue ulcers to develop.[22] The concepts of sensory perception, mobility, and activity are influenced by the intensity and the duration of pressure. Secondly, the tolerance of the tissue for pressure is affected by extrinsic factors, such as moisture and friction and shear force on the skin, and intrinsic factors, such as nutritional status, aging, and core temperature that induces higher skin temperature, which influence skin integrity.

Hypotheses

1. Decreases in sensory perception, mobility, activity, and nutrition, and increases in moisture, friction and shearing, age, and core temperature, increase the risk of pressure ulcers in the hospitalized elderly.

2. Decreases in sensory perception, mobility, activity, and nutrition, and increases in moisture, friction and shearing, age, and core temperature, can predict the risk of pressure ulcers in the hospita-lized elderly.

MATERIALS AND METHODS

Population and Sampling

The eligible population for this study were the patients 60 years or older who were admitted to male or female medical, surgical and orthopedic nursing units of Pranangklao Hospital, a tertiary care general hospital in Nonthaburi Province, from January 9th, 2002 to March 12th, 2002.

Inclusion and Exclusion Criteria

All hospitalized elderly patients who within 24 hours of admission were expected to be hospitalized for at least 4 days were included in this study. Elderly patients who had pressure ulcers on admission, or who had pre-existing skin diseases, and were hospitalized for less than 4 days were excluded from the study.

Sampling

Thirty nine elderly patients who developed pressure ulcers (case group) and 78 elderly patients who did not develop pressure ulcers (control group) were included in this study. The samples were selected by proportional stratified random sampling procedure from the eligible population. Proportional random sampling for this study was based on the proportion of new elderly admitted to each nursing unit in the year 2000. For the statistical data analysis, simple random sampling for the case and the control groups based on the proportion in each nursing unit was used to reduce data selection bias.

Setting

Pranangklao Hospital, a 430-bed tertiary hospital in Nonthaburi Province, was selected for this study. During the data collecting period (January 9th, 2002 to March 12th, 2002), it was found that there was a large amount of newly admitted patients. The high admission number of new elderly patients together with the limitation of hospital beds led to the shrinkage of hospital stay among the majority of the elderly patients affected the nurses' workloads. The nurses in all study units were below normal staff levels and most of them complained about the work overload and burnout. Due to the shortage of nurses as well as the high workload of the health care personnel in the study setting, family caregivers were allowed to stay with all patients at all time. They also played vital roles in conducting routine care for the patients such as taking care of body cleaning, nutrition uptake, and activities of daily living. Also it was found that all the above approaches almost solely depended on the caregivers' capabilities or awareness.

In this study setting, there were three approaches for pressure ulcer prevention. The approaches included using supporting devices, encouraging caregivers to mobilize the patients, and using a repositioning schedule. When pressure ulcers were detected, there were various techniques to prevent further skin damage and to promote healing processes. Applying a hydrogel or a hydrocolloid dressing, wet wound dressing with normal saline solution, monitoring the wound for its changes, were routinely performed.

Instruments

The research instruments were composed of three parts. 1) General Information Form. This assessment tool contained a checklist concerning information about demographic and clinical characteristics of the samples. 2) Pressure Ulcer Risk Assessment Tool. This tool was composed of two parts, i.e. an age and temperature rank scale and the Braden Scale. The Braden Scale is a pressure ulcer risk assessment tool, which was developed by Braden and Bergstrom (1988). In this study, the Braden Scale was used with permission. The factors on the Braden Scale are presented as follows: sensory perception, moisture, activity, mobility, nutrition, and friction and shear forces. Each sub-scale is scored from 1 to 4, except friction and shear which is scored from 1 to 3. The total rating ranges from 6 to 23 points. The level of severity, as suggested by Braden and Bergstrom (1988), is related to the score, and is as follows:12 or less = high risk, 13-14 = moderate risk, 15-16 = mild risk for $\leq$ 69 years old, and 15 -18 = mild risk for $\geq$ 70 years old. 3) Skin Assessment Tool. This instrument was developed by Bergstrom.[19] In this study, the Bergstrom skin assessment tool was used with permission. This tool is used for recording

the appearance of pressure ulcers, especially at 28 bony prominence areas. It is composed of a human picture with 28 of potential pressure ulcer sites. The definitions of the score are: 0 = no pressure ulcer, 1 = pressure ulcer stage 1, 2 = pressure ulcer stage 2, 3 = pressure ulcer stage 3, 4 = pressure ulcer stage 4.

Validity and Reliability

The instruments were reviewed by three experts for the validity of the content and the appropriateness of the language. The inter-rater reliability (K) of the Braden Scale was .895. When including the temperature rank, the reliability was .905. The inter-rater reliability of skin assessment between the two raters was .954.

Data Collection

The researcher and the assistant collected data by observation using the study instruments and by interviewing all participants or their representatives in order to explain situation. The researcher completed part one of the pressure ulcer risk assessment tool, general information form and assessed age rank scale on the first day of study. Both the researcher and the assistant completed the temperature rank scale, the Braden Scale, and skin assessment daily. Each participant was assessed at the same time each day through 4 days of the study.

Protection of Human Subjects

The research proposal was presented to the Director of Pranangklao Hospital. Also, the details of this study were explained to the nursing staff in the setting. All clients or his or her representatives were informed about the objective of the study and the procedure before being asked for their collaboration. Throughout this study process, the researcher carefully undertook every procedure to avoid any possibility of discomfort, physical and/or emotional harm.

Data Analysis

The collected data were categorized and keyed into a computer using SPSS version 10.0.7. Descriptive statistics were used to describe the demographic, physical, and clinical data of the cases and the controls. Chi-square test was used to examine crude association between pressure ulcer development and each independent variable. Forward stepwise logistic regression analysis was used to investigate the factors predicting pressure ulcer development in the hospitalized elderly.

RESULTS

One hundred forty eight of the 394 new elderly patients admitted to the six nursing units participated. Of these 148 elderly patients, 117 were selected by random sampling procedure for analysis. Twenty-four of the newly admitted elderly (6.1% of 394 elderly) who participated in this study, died (1.5%) or were discharged before the fourth day of admission (4.3%). Only one participant (0.3%) dropped out of the study because of the influence of the caregiver, who felt uncomfortable working under the researcher's procedures of assessing pressure ulcer occurrence. The majority of elderly patients with pressure ulcers were male (53.8%). Most of these elderly patients were married (64.1%) and did not have a caregiver during hospitalized periods (53.8%). A Chi-square test of gender ($\chi^2 = .00$, p-value = 1.000), marital status ($\chi^2 = .163$, p-value = .922), caregiver ($\chi^2 = .017$, p-value = .896), and patient-caregiver relationship ($\chi^2 = .374$, p-value = .671) between the controls and the cases showed that there were similar proportions in the two groups. The clinical characteristics of the elderly in both groups (Table 1) showed that the average length of hospital stay and the mean actual ages of the elderly who developed pressure ulcer were significantly longer and older than those who did not.

Medical Diagnoses: 10 categories of medical diagnosis related to systemic disease are shown in Table 2. Most of the elderly patients had co-morbidity with the illness which precipitated admission. The three most frequent diagnoses in the case group were neurological and spinal diseases (38.4%), respiratory diseases (20.5%), and cardiovascular diseases (17.9%). While the control group had a frequency of neurological and spinal diseases of 26.9%, cardiovascular diseases 19.2%, and gastrointestinal diseases 17.9%. 44.9% of the controls and 53.8% of the cases had no co-morbidity. However, this difference was not statistically significant (Table 3).

Risk Exposure: Most of the patients were 70-79 years old. On the first day, 64.1% of the patients were assessed as having a high risk score for temperature (higher than 37.6°) and 73% of these elderly were assessed as being at risk of developing pressure ulcers by the Braden Scale (Braden scores =13.7, S.D.= 3.9). The mean Braden Scores of the

Table 1. Clinical characteristics of the participants without pressure ulcers (controls) and with pressure ulcers (cases) (n = 117).

Characteristics	Pressure ulcers occurrence		t-test / χ^2	p-value
	Controls	Cases		
Length of hospital stay (days) Mean ± S.D. (Range 4 - 56 days, Mode = 6)	9.3 ± 7.0	12.4 ± 9.9	-1.962*	.026
Length of study duration (days) Mean ± S.D. (Range 4 - 14 days, Mode = 14)	7.9 ± 3.8	9.6 ± 3.2	-2.492**	.007
Left mid arm circumferences (cm) Mean ± S.D.				
First participation (n = 117)	26.5 ± 4.5	23.6 ± 3.5)	3.548***	< 0.001
1 week (n = 59)	26.3 ± 4.6	23.5 ± 2.8)	2.687**	.005
2 weeks (n = 23)	25.3 ± 3.5	22.9 ± 2.9)	1.482ns	.076
Mean age ± S.D. (Range 60-88 years)	69.62 ± 7.35	72.92 ± 8.10)	-2.218*	.014
Mean temperature ± S.D. (Range 35.5-39.5°C, Mean = 37.2, S.D. = .9)	37.1 ± 0.8	37.4 ± 1.0)	-1.731*	.043
Mean pulse ± S.D. (Range 60-126 beats/min, Mean = 90.46, S.D. = 14.46)	89.41 ± 13.99	92.56 ± 15.33)	-1.113ns	.134
Mean respiratory rate ± S.D. (Range 16-36 times/min, Mean = 22.2, S.D. = 3.19)	21.72 ± 2.25	23.18 ± 4.39)	-1.953**	.029
Mean systolic pressure ± S.D. (Range 90-210 mmHg, Mean = 138.9, S.D. = 22.31)	134.95 ± 22.03	146.79 ± 20.98)	-2.785**	.003
Mean diastolic pressure ± S.D. (Range 60-130 mmHg, Mean = 84.26, S.D. = 14.72)	81.92 ± 14.60	88.92 ± 13.99)	-2.479**	.007
Drug usage (%)	78 (100)	39 (100)	3.819ns	.051
No	38 (38.5)	8 (20.5)		
Yes	40 (61.5)	31 (79.5)		
Hypnotic & sedative	3 (3.8)	0 (0)		
Analgesic	30 (38.5)	18 (46.2)		
Steroid	4 (5.1)	2 (5.1)		
Hypnotic & sedative & analgesic	7 (9.0)	5 (12.8)		
Analgesic & steroid	3 (3.8)	2 (5.1)		
Hypnotic & sedative & analgesic & steroid	1 (1.3)	4 (10.3)		

* = Statistical significance at level .05, ** = statistical significance at level .01, *** = statistical significance at level .001, ns = no statistical significance

Table 2. Numbers and percentages of study groups categorized by medical diagnoses.

Medical Diagnoses	Controls (n = 78)		Case (n = 39)		Total (n = 117)	
	Number	%	Number	%	Number	%
Neurological & spinal diseases	21	26.9	15	38.4	36	30.8
Cardiovascular diseases	15	19.2	7	17.9	22	18.8
Respiratory diseases	12	15.4	8	20.5	20	17.1
Gastrointestinal diseases	14	17.9	2	5.2	16	13.6
Endocrine diseases	3	3.8	2	5.2	5	4.3
Orthopedic diseases	6	7.7	2	5.2	8	6.8
Infectious diseases	3	3.9	2	5.2	5	4.3
Hematological diseases	1	1.3	1	2.5	2	1.7
Urological & nephrological diseases	2	2.6	0	0	2	1.7
Neoplastic diseases	1	1.3	0	0	1	0.9

Table 3. Comparison of the number, percentage, and Chi-square of the elderly with pressure ulcers (cases) and the elderly without pressure ulcers (controls) categorized by co-morbidity.

Co-morbidity	Controls n (%)	Cases n (%)	χ^2	p-value
Without co-morbidity	35 (44.9)	21 (53.8)	.839^{ns}	.360
With co-morbidity	43 (55.1)	18 (46.2)		

ns = No statistical significance.

cases were lower than the mean Braden Scores of the controls throughout the 4 study days.

Pressure Ulcers Occurrence: Pressure ulcer occurred most frequently in patients who were 70-79 years old (41%). The incidence of pressure ulcers was 33.3%. Most pressure ulcers were found on the second and fourth days (35.9%), but on the second day the severity of pressure ulcers was greater than on the fourth day.

The crude analysis of the relationship between the 8 risk factors and pressure ulcer development revealed that there were 5 risk factors were significantly related to pressure ulcer development (Table 4). Those factors were temperature ($\chi^2 = 6.838$, $p = .009$), sensory limitation ($\chi^2 = 2.436$, $p = .006$), reduced mobility ($\chi^2 = 15.548$, $p = .001$), moisture ($\chi^2 = 8.981$, $p = .030$), and friction and shear forces ($\chi^2 = 17.518$, $p < .001$). While the other 3 factors, i.e. age ($\chi^2 = 4.225$, $p = .119$), activity ($\chi^2 = 6.826$, $p = .078$), and nutrition ($\chi^2 = 1.571$, $p = .666$) had no relationship to pressure ulcer development.

The existing odds ratios which provided the predictive levels of the risk factors were included in the predictive model (Table 5). Regarding increasing core temperature, under the 95% confidence area, patients with a core temperature of higher than 37.6°C (OR = 2.760, 95%CI = 1.105- 6.891) had a great risk of developing pressure ulcers than patients with a core temperature of 35.4 to 37.6°C (OR = .202). Patients who had a friction and shearing score of 1 on the Braden Scale (OR = 4.592, 95%CI = 1.531-13.770), using the 95% confidence area, had a greater risk of developing pressure ulcers than patients who had a score of 3 for the friction and shearing factor. Of the two risk factors, individuals who had problems with friction and shearing forces (OR = 4.952,

Table 4. Factors related to pressure ulcer development as presented by the number, percentage, and Chi-square test of the cases and the controls (data from the frist day of the study)

Risk factors / Scores	Controls n (%)	Cases n (%)	χ^2	p-value
Age			4.255^{ns}	.119
1 = ≥ 80 years	10 (12.8)	9 (23.1)		
2 = 70-79 years	25 (32.1)	16 (41.0)		
3 = 60-69 years	43 (55.1)	14 (35.9)		
Temperature			6.838**	.009
1 = > 37.6°C	16 (20.5)	17 (43.6)		
2 = 35.4-37.6°C	62 (79.5)	22 (56.4)		
Sensory			2.436**	.006
1 = Completely limited	3 (3.8)	3 (7.7)		
2 = Very limited	7 (9.0)	13 (33.4)		
3 = Slightly limited	21 (26.9)	7 (17.9)		
4 = No impairment	47 (60.3)	16 (41.0)		
Mobility			15.548***	.001
1= Completely immobile	3 (3.8)	8 (20.5)		
2 = Very limited	21 (26.9)	17 (43.6)		
3 = Slightly limited	31 (39.7)	10 (25.6)		
4 = No limitation	23 (29.6)	4 (10.3)		
Activity			6.826^{ns}	.078
1 = Bed-fast	62 (79.5)	38 (97.4)		
2 = Chair-fast	2 (2.6)	0 (0)		
3 = Walks occasionally	2 (2.6)	0 (0)		
4 = Walks frequently	12 (15.4)	1 (2.6)		
Moisture			8.981*	.030
1 = Constantly moist	11 (14.1)	15 (38.5)		
2 = Very moist	5 (6.4)	2 (5.1)		
3 = Occasionally moist	21 (26.9)	8 (20.5)		
4 = Rarely moist	41 (52.6)	14 (35.9)		
Nutrition			1.571^{ns}	.666
1 = Very poor	58 (74.4)	32 (82.1)		
2 = Probably inadequate	5 (6.4)	2 (5.1)		
3 = Adequate	12 (15.4)	3 (7.7)		
4 = Excellent	3 (3.8)	2 (5.1)		
Friction & shear			17.518***	< .001
1 = Problem	19 (24.4)	25 (64.1)		
2 = Potential problem	35 (44.9)	8 (20.5)		
3 = No apparent problem	24 (30.8)	6 (15.4)		

* = Statistical significance at level .05,** = statistical significance at level .01, *** = statistical significance at level .001, ns = no statistical significance.

Table 5. Logistic regression analyses of the factors associated with pressure ulcer development in the elderly as presented by the number of statistically analyzed cases, the number of risk exposed elderly, logit coefficient (β_i), odds ratio (OR), and 95% confidence interval on the first day of the study

Risk factors / Score	Control (n)	Case (n)	β_i	OR	95%CI
Temperature					
1 = > 37.6°C	16	17	1.015	2.760	1.105 - 6.891
2 = 35.4 - 37.6°C*	62	22	-1.597	.202	-
Friction & shear					
1 = Problem	19	25	1.524	4.592	1.531 -13.770
2 = Potential problem	35	8	-0.227	0.797	0.238 - 2.669
3 = No apparent problem*	24	6	-1.597	0.202	-

* = Reference group.

95%CI = 1.531-13.770) had a higher probability of deve-loping pressure ulcers than patients who had a high core temperature (>37.6°C) (OR = 2.760, 95%CI = 1.105- 6.891).

DISCUSSION

The General Characteristics of the Samples

Stage 1 pressure ulcers were the most common finding in this study. The incidence of pressure ulcers was similar to the incidence in the study of Khawanmuang R and others[12] in medical units of a tertiary care hospital. The explanation of this finding is that during the study period, the patients were assessed daily for their pressure ulcer risk. Their skin was inspected thoroughly once a day until the end of the study. Stage 1 pressure ulcers were consequently detected before they progressed to an advanced stage. This suggests that monitoring is one of the most effective strategies to prevent pressure ulcers.

On admission, the controls and the cases showed a significant difference in their respiratory rate, systolic blood pressure, and diastolic blood pressure. This may be a result of the higher core temperatures and the ages of the cases (Table 1). Pre-disposing nutritional status, as assessed by measuring the left mid arm circumference on the first participation day, of the cases (mean = 23.6, S.D. = 3.5) was found to be poorer than the pre-disposing nutritional status of the controls (mean = 26.5, S.D. = 4.5). All of these findings reflect the clinical condition of the patients on admission. The data also indicated that most of the elderly with pressure ulcers were admitted in a more severe clinical condition than the elderly without pressure ulcers.

The Risk Factors of Pressure Ulcers Among the Hospitalized Elderly Patients

Increasing core temperature, decreasing sensory perception, decreasing mobility, increasing moisture and increasing friction and shearing forces were factors that were related to pressure ulcers development among the hospitalized elderly. Within these five factors, core temperature and friction and shearing forces were predictive factors for pressure ulcers. Discussion regarding these risk factors is as follows:-

Predictive Factors

Core Temperature

It is apparent from this study (Table 4) that a core temperature higher than 37.6°C was significantly associated with pressure ulcer development. The results of this study are similar to the studies of Braden & Bergstrom[22] and Yamwong C and others[1] who found that increasing body temperature increased the risk of pressure ulcers. The literature shows that any condition which gives rise to an inflammatory response or fever causes an increase in tissue metabolism due to an increase in tissue or body temperature.[18] In this study, most of the patients with pressure ulcers had significantly higher temperature and mean respira-

tory rate than those without pressure ulcers. Most of the patients with pressure ulcers had neurological or spinal diseases, cardiovascular diseases, and respiratory diseases, which led to a high metabolic rate. It has been reported in a previous study that skin temperatures were increased by 0.83 degrees Fahrenheit in immobilized patients.[23] In addition, hyperventilation or abnormal breathing as a result of respiratory disease causes dehydration and also led to an increased core temperature. Increasing the core temperature by one degree Celsius can induce a t10% increase in tissue metabolism and lead to anoxia as well as tissue necrosis especially in tissue that was compressed by a constant pressure.[24]

Friction and Shearing

Friction and shearing forces were positively related to pressure ulcer development in the study samples. This result was similar to a study of the critically injured by Baldwin & Ziegler[25] and a study performed in long term care facilities by Vap & Dunaye,[26] which reported that friction and shearing forces were primary factors contributing to pressure ulcer development.

In this study, patients who were prone to friction and shearing forces were 4.59 times more likely to develop pressure ulcers when compared with patients who did not experience this (Table 5). The explanation is that those that developed pressure ulcers had more severe illnesses than those who did not develop pressure ulcers. The majority of patients who developed pressure ulcers had reduce ability to move in bed or transfer to a chair independently and had insufficient muscle strength to lift their bodies up completely. Most of the patients in this group had neurological or spinal diseases. Unavoidably, they required moderate to maximum assistance in moving, positioning, and transferring. Also, they had difficulty in stabilizing their position or re-positioning themselves. When they were arranged in the upright position they usually slid down against the bed sheet. The patients in this group also suffered from respiratory and musculoskeletal diseases. These caused muscle weakness and made it difficult for them to position themselves and maintain their position.

The Predictive Level of the Risk Factors for Pressure Ulcers Among the Hospitalized Elderly Patients

In this study, the statistical analysis for predictive factors showed that the predictors for pressure ulcers development in this study were increasing core temperature and increasing friction and shearing forces. Of the two predictors, increased friction and shearing forces were more strongly associated with pressure ulcer development than an increased core temperature. During the study period, there were various situations in the study setting which led the participants to be more prone to increased friction and shearing forces than to increased core temperature. Therefore, the strength of association of increasing friction and shearing forces to pressure ulcer development was more than the strength of association of increasing temperature. However, the result of this current study differed from the results of previous studies. A previous prospective study, in neurologically injured patients[25] in an academic health-science center hospital, found that factors on the Braden Scale, which were related to pressure ulcer development were the 1 and the 2 scores for mobility, as positive predictors, and the 1 and the 2 scores of the moisture sub-scale, as negative predictors. A retrospective cohort study[9] had showed 10 factors which were positively related to pressure ulcer development. These factors were limitation in activity to a wheelchair, ADL dressing (needed assistance), bowel/bladder incontinence, anemia, adult child as primary caregiver, male gender, recent fracture, oxygen use, and skin drainage, and mobility sub-scale on the Braden Scale (OR= 5.2002, 95%CI =2.4404-11.0811). Only a few studies have reported the pressure ulcer risk factors in an epidemiological study. Thus, none of the previous reports have compared the strength of association between increased friction and shearing forces, and increased core temperature with pressure ulcer development. This finding confirms the earlier belief of the researcher that more epidemiological researches to improve the understanding of risk factors for pressure ulcers development are desperately needed.

Implication and Recommendation

Recommendation for Nursing Practice

1. Pressure ulcer risk assessment coupled with skin assessment should be performed as follows: newly admitted elderly patients should be assessed on admission using the Braden Scale and the Bergstrom' s skin assessment tool. If the Braden Scale is equal to or less than 18, daily assessment needs to be continued. If the pressure ulcer risk assessment score on the Braden Scale is higher than 18, pressure ulcer risk assessment should be conducted when the patient clinical condition changes, such as developing an episode of acute illness or undergoing an operation or some treatment procedures, because these circumstances cause an increased risk of pressure ulcers.[27]

2. Pressure ulcer prevention strategies should be conducted for all newly admitted patients who are exposed to friction and shearing forces, and have high core temperature. The development of an intervention and educational program for reducing friction and shearing forces, and core temperature should be emphasized.

Recommendations for Further Study

1. Interventions to reduce friction and shearing force as well as core temperature for elderly patients who are prone to these risk factors should be conducted and should be tested for effectiveness by a quasi-experimental study.

2. The study of risk factors of pressure ulcers should be conducted in a larger group of elderly patients and in intensive care units to discover all causative factors for hospitalized elderly patients in each unit.

Limitation

The limitations of this study are firstly, the characteristics of the study setting which had different procedures for pressure ulcer prevention between nursing units which might have affected pressure ulcer development in some circumstances. Secondly, this study did not aim to involve the prevention strategies of the unit staff, so the research instrument did not contain questions regarding prevention strategies, which might explain the high incidence of pressure ulcer development in the patients. Thirdly, only a 4-day study was conducted because of a limitation in the number of patients who were admitted for a long stay and the limited time frame to complete this study. The result of this study may not be appropriate to use for elderly individuals who stay in the hospital for longer than 4 days. Therefore, a further study with large number of the elderly patients with a long hospital stay should be conducted. In addition, the results from this study can be used to explain pressure ulcer development in the coccyx area only. Lastly, the nutrition score on the Braden Scale probably cannot be used to investigate nutritional status, which affects skin integrity over such a short study period.

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