Wearing evaluation of hip protector design for hip fracture prevention

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INTRODUCTION

- In the elderly, hip fractures due to falling result in functional disability, and decrease the quality of life and finally lead to death.
- Nowadays, Korea is entering the aging society, and as the elderly population increases, the social and economic costs due to hip fractures are on the rise.
- Hip protectors that are sold in Korea are imported from the United States and Canada, these are not suitable for the Korean elderly's body.

PURPOSE OF STUDY

- If the Korean elderly wears imported hip protectors which fitted to westerners, the hip joint may not be protected properly.
- In this study, the survey was conducted to find out the wearing characteristics of hip protectors. The problems of the existing products were identified and the directions of improvement were presented.

METHODS

(1) Questionnaire

- Question items for wearing characteristics based on the results of market research were derived and finally, the questionnaire was made.
- After wearing different kinds of hip protector, the participants were answering the questionnaire.

(2) Evaluation process

- The evaluation of wearing characteristics was carried out to 100 elderly women at 3 different senior welfare centers in 2014. The participants' ages ranged from 60 to 85 years old.

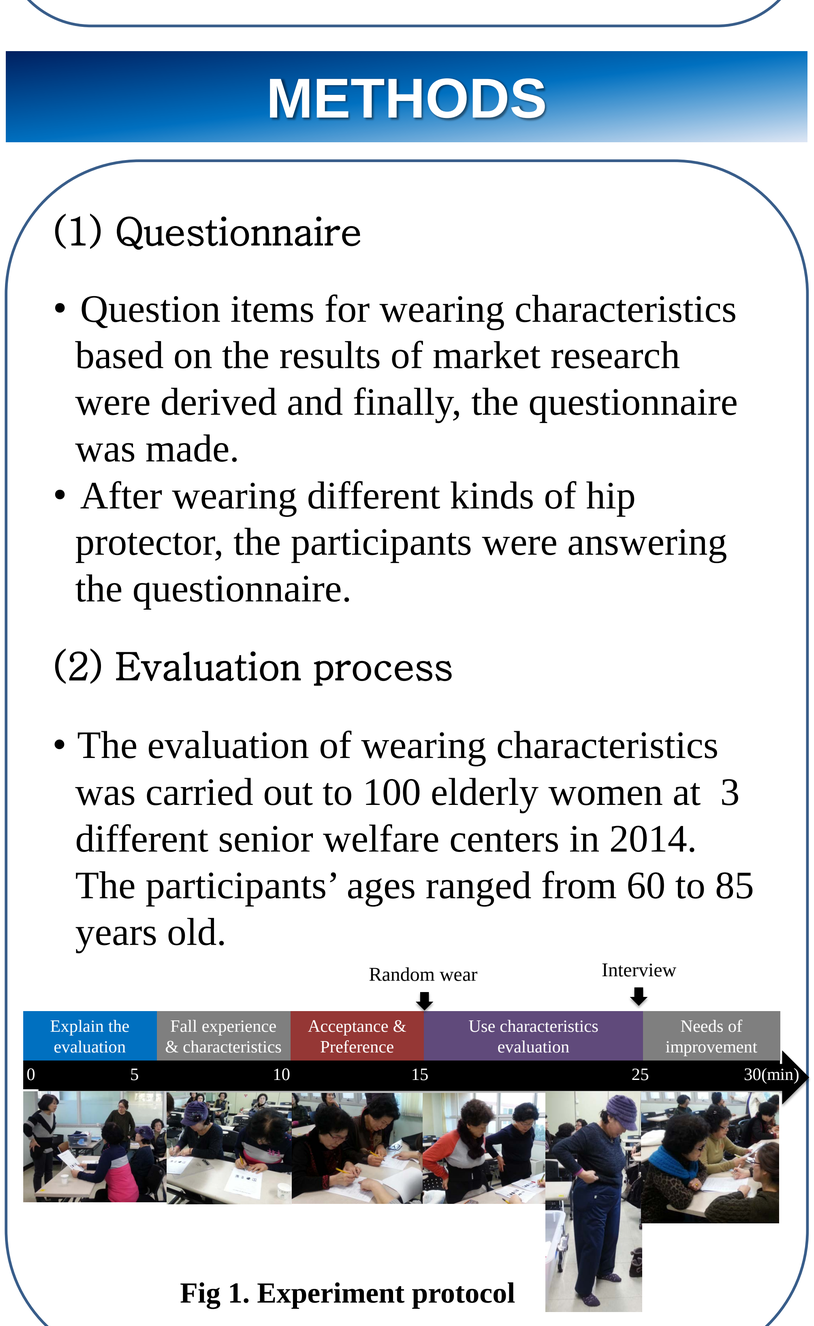


Fig 1. Experiment protocol

(3) Evaluation item

- Characteristics of falling (season, place, cause, activity, direction of falls, and fracture site)
- Acceptance of hip protectors (injury prevention effect, purchase decision, product recognition, necessity, protection areas, and wearing problems)
- Preference (design and details)
- Easy wear (subjective satisfaction)
- Improvement requirements

(4) Evaluation hip protector

Table 1 Hip protector type

Belt type	Waist belt type	Underwear type	Slacks type	Pad type
				
SAFEHIP® ECTIVE	SAFEHIP® DORSO	SAFEHIP® CLASSIC	HipSaver® SOETSWEATS	SPOTEC® Pad

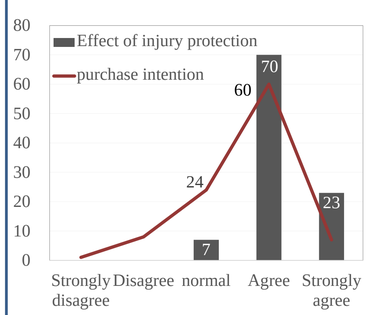
RESULTS

[1] History and characteristics of falling

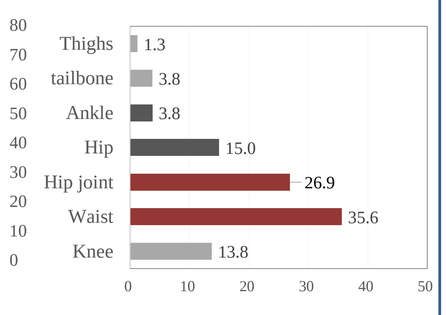
- 52 % of the subject experienced falling in winter. Falling were occurred in outdoors(74.5%), bathroom(10.9%), and kitchen(5.5%).
- Falling were caused mainly during walking (60.4%), wrist joint were the most common fracture site(26%). 24% of injury occurred in knee joint, 16% in lumbar joint, 14% in ankle joint, respectively.

[2] Acceptance of hip protector

- 93% of subjects said that the hip protector was effective in preventing injury(Fig 2-a). Necessity of hip protector is tended to increase as age increases.
- The body parts wanted to protect were in several areas: 35.6% for lumbar, 26.9% for hip joint, and 15% for hip bone(Fig 2-b).



(a) Effect of injury protection & purchase intention

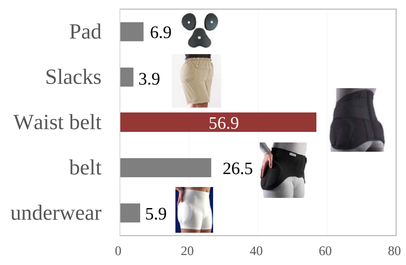


(b) Preference areas for protection

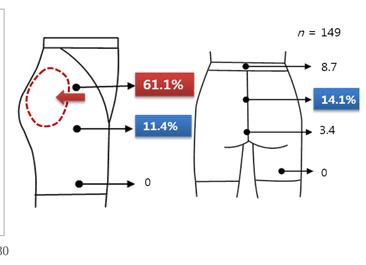
Fig 2. Acceptance of hip protector

[3] Preference of hip protector

- 56.9% of participants preferred a waist belt type design because it gives a sense of stability by clinging to the body and upholding the waist(Fig 3-a).
- The desired attachment locations of the pad were hip joint(61.1%), followed by hip(14.1%), and thigh(11.4%)(Fig 3-b).



(a) Design preference

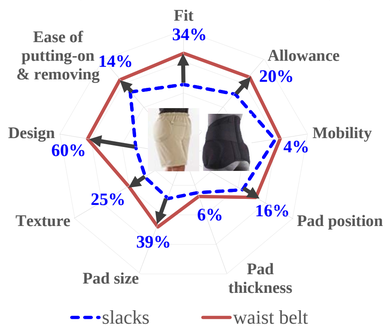


(b) Pad placement preference

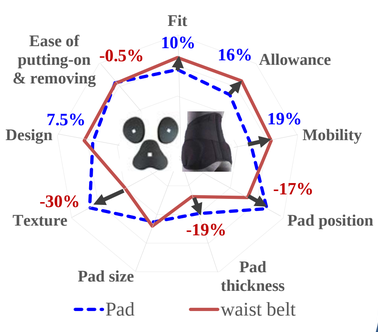
Fig 3. Preference of hip protector

[4] Evaluation ease of wear

- **W**aist belt type was the most appropriate in terms of fit, allowance, mobility, and design except pad thickness(≤3) as shown in Fig 4-a.
- Waist belt type was preferred to slacks type by 60% for design, 39% for pad size, 34% for fit, 25% for texture, and 20% for allowance.



(a) Slacks vs. waist belt



(b) Pad vs. waist belt

Fig 4. Evaluation ease of wear

DISCUSSION

- To *reduce the risk* of hip fracture, hip protector needs to be designed in consideration of user's *body type* and *type of fall*.
- The *pattern* and *size* of hip protector has to be improved in the order of *discomfort rate* on each part, thigh(52%), waist(28%), chest(13%) and abdomen(7%).
- *Objective evaluation* is needed for ergonomic design of hip protector based on the analysis of *3 D body image* of the elderly and *shock-absorbing quality of pad.*

REFERENCES

[1] Compston, J. 2008, Prescriber, 19, 7–9.
[2] Kannus, et al., 2000, New England Journal of Medicine, 343,1506-1513.
[3] Kim., Y. 2009, J. of the Ko. Gerontological Society, 29(1), 21-35.
[4] O'Halloran, et al., 2005, International Journal of nursing studies, 42, 387-397

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