Effects of Housing Conditions and Environmental Factors on Accidents and Modification Intention of the Vision Impaired

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Abstract
The purpose of this study is to investigate (1) whether housing conditions and environmental factors influence the occurrence of accidents, and (2) the level of intention to make modifications to housing for people who are visually impaired. Results from 148 questionnaires collected in Korea show a significant difference in the occurrence of accidents between those in the high environmental demand group (HED) and those in the low environmental demand group (LED), revealing that visually impaired people living in more difficult housing environments are likely to have more falls than people living in housing without as many obstructions. For the elderly, housing conditions have a greater influence on the probability of accidents. For respondents with low vision, housing conditions appeared to be a more significant factor than for people with no vision. People with good health and under LED rated their life satisfaction higher and modification intention lower than people under HED and with a bad health condition.

Keywords: home accidents; environmental demand; falls; vision impairment; housing modification

1. Introduction
The number of vision-impaired people has been continually increasing in tandem with the aging of the overall population. Even though vision impairment is an independent factor, it can increase the risk of accidents — including falls — in elderly adults when in combination with other issues, such as impaired mobility (Ivers et al., 2000). Previous findings reveal that when falls and home accidents occur in home environments of the elderly, the falls could result in more serious injury than for other demographic groups (Steinman, Pynoos, & Nguyen, 2009).

Some guidelines and regulations regarding daily life have been suggested for people with vision impairment; however, there is a lack of empirical studies that describe environmental changes that could provide support for the vision impaired and reduce the risk of accidents in the home. Furthermore, little is known about the housing and modification needs of people with vision loss (Lewis & Torrington, 2013), as previous research has focused on the disadvantages faced by people with sight loss due to ignorance and stereotyping (Hanson & Percival, 2005).

In addition, checklists, guidelines, and regulations need to be considered under specific environmental conditions and circumstances, such as highly populated dwellings in Korea. Riazi et al. (2012) emphasize the need for different interventions when applying overgeneralized guidelines; for example, they suggest that industrial and interior designers ask themselves "good for whom?" and to consider individual needs, capabilities, and lifestyle.

Therefore, it is important to understand the housing conditions of the vision impaired, and whether their housing circumstances influence the incidents of falls and their overall life satisfaction.

The purpose of this study is to investigate the housing conditions and environmental factors of the visually impaired, and whether these housing conditions influence the occurrence of accidents and their intention to make modifications.

2. Literature Review
2.1 Home Hazards, Accidents, and Falls
Environmental hazards can be any objects or physical circumstances within the home and near environment (Tse, 2005).

In the home environment, the three primary hazardous locations are the kitchen, steps, and bathroom, with slippery floor surfaces being the major hazard in the latter. People with central vision loss have difficulty seeing glass doors; thus, a number of difficulties and hazards exist outside the home in...
public areas such as bus stations and other buildings (Riazi et al., 2012).

The most common hazardous conditions in homes are inadequate lighting, unsafe/insecure floor surfaces, existence of staircases, poorly designed or arranged furniture, and poorly designed tubs, toilets, and fixtures in the bathroom (Steinman, Pynoos, & Nguyen, 2009). In addition, confined spaces are often hazardous due to small, unseen objects or corners of furniture, which can cause impediments and possible accidents (Percival, Hanson, & Osipovic, 2006).

People with age-related macular degeneration (AMD) perceive that they are at risk of accidents and falls in their homes (Riazi et al., 2012). Riazi’s study found that participants expressed fear in regard to accidents on stairs, and falling. Fear in this group was also related to an inability to detect the correct buttons to push, as pushing the wrong button may lead to fire or accidents. In addition, Wood et al. (2011) revealed that there is a positive relationship between home accidents and visual impairment in older people.

The more environmental hazards that exist in a home, the more likely it is that elderly people will experience a fall (Fletcher & Hirdes, 2002).

2.2 Home Modification and Needs of the Vision Impaired

Home modification strategies are suggested to reduce the risk of falls or accidents in the home and mitigate risk factors for the elderly. Home modification includes removing cords from the floor, changing lighting fixtures, installing grab bars, elevating the toilet seat, and installing emergency alarms (Lord, Sherrington & Menz, 2001; Nikolaus & Bach, 2003).

According to a study done by Hanson & Percival (2005), approximately half of the participants had made physical alterations or adaptations to their homes to cope with vision impairment. Although results have not been consistent in proving that home modification can be effective in preventing falls and that environmental changes can result in positive differences (Chang et al., 2004), multifactorial strategies are more likely to reduce their occurrence.

In addition to environmental modifications, various intervention strategies are necessary to reduce accidents and falls in the home (e.g., individual characteristics, capabilities, and housing experiences). According to Percival et al. (2006), modifications present a challenge to people with vision impairment because all disabled people are different, and there is a lack of adequate regulations and guidelines.

Some studies have investigated environmental conditions with the goal of helping the visually handicapped navigate their surroundings (Kametani, Kishigami, & Chibana, 2006a, 2006b; Motlagh et al., 2009; Hwang, 2011). The findings suggested that smaller spaces and right-angle corners are less difficult for the vision impaired to recognize (Kametani, et al., 2006a). Providing tactile maps, handrails, and door signs have also been shown to help to reduce travel time (Hwang, 2011).

3. Methodology

3.1 Research Method and Procedure

Through the literature review, a structured questionnaire was developed. Prior to the survey, a pilot test was conducted to ensure clarity and ease of understanding of the questionnaire items. The questionnaire was reviewed by professionals who work with or for people with vision impairment, and employees or assistants at sight-loss rehabilitation centers verbally posed the questions to each participant. Questionnaires were collected from 150 participants and 148 usable responses were analyzed using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree) or "yes" or "no" options. The data were analyzed using IBM’s SPSS 20 statistical software.

3.2 Conceptual Framework: Person-Environment Fit Model

People with sight loss are more likely to confront risk situations in which their environments fail to accommodate the special needs associated with chronic sight loss. This results in a person-environment misfit (Wahl, Oswald, & Zimprich, 1999).

![Person-Environment Fit Model](image)

Fig. 1. Person-Environment Fit Model: Housing Accidents and Environmental Characteristics (Adapted from Altman et al., 1984, p. 202).

Environmental demands:

Depending on environmental characteristics, the degree of perceived environmental demand could differ among those with vision loss. Environment demand refers to the degree to which respondents in this study experience obstacles/hazards or difficulties/inconveniences in their home environments.

Previous research indicates that there are few existing assessment measures by which to gauge environmental conditions, especially regarding environmental demand (Edwards et al., 2006; Lawton, 1983). In this study, respondents were divided into two groups based on whether they perceived environmental conditions from their housing as generally difficult or inconvenient, or not generally difficult or inconvenient. The two groups were designated as high environmental demand group (HED) and low environmental demand group (LED).

In order to understand the distinct differences between the two groups, the following environmental demand items were investigated: environmental risks...
(hazards), difficulties within the home, difficulties in using objects, proper lighting, and quality of environment (heating/venting) (Table 1.). For each factor, environmental demand items were measured on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). In addition, Cranach’s alpha coefficients for each factor are presented in parentheses for the reliability test. The mean difference is significantly apparent between the two groups. Except for lighting and indoor environment conditions, the two groups showed considerably different levels in how they feel about the demands of their environment. Those in the HED group were more likely to rate their home environment as hazardous (t = 5.303, p<0.001), inconvenient (t = 6.292, p<0.001), or find it difficult to use home appliances or to locate things (t = 4.769, p<0.001).

According to the theoretical model, it is assumed that high environmental demand coupled with ability impairment (e.g., vision loss) results in a high probability of accidents or falls. 

**Personal characteristics:**

Previous studies of person-environment fit have focused on individual differences (Kaplan, 1983); however, since age-related visual difficulties exist in combination with impaired mobility and cognition, it is necessary to investigate whether accidents and falls occur differently between younger and older adults living with vision impairment (Hanson & Percival, 2005).

Different needs and housing considerations are required for different types of vision impairment (Steinman et al., 2009), as the lower the competence of the individual, the more pronounced the impact of environmental conditions on the person’s behavior (Wahl, Oswald, & Zimprich, 1999; Steinman et al., 2009). Because health conditions are related to an individual’s capability to independently engage in daily activities, conditions such as vision impairment in active people are assumed to be associated with accidents and falls.

**Housing type:**

Housing type has not been identified as a direct indicator of home accidents and falls; however, guidelines and checklists emphasize removal of level differences and steps as a preventative measure (Stevens, Holman, & Bennett, 2001). Therefore, in this study, housing type was examined.

**Outcomes: modification intention and satisfaction:**

According to Riazi et al. (2012), housing modifications could assist in creating a better quality of life as people adapt to vision loss, and reducing difficulties in performing daily activities (Gitlin et al., 2006). Many people with vision impairment make an effort to adapt to their environment and modify their housing so that they can achieve a desired level of daily activity. Home modifications can be either a proactive or reactive strategy to reduce possible risks and support special needs for people with vision loss. However, costs are often a major barrier to implementation (Pynoos et al., 2012). In this study, modification intention and life satisfaction were investigated, with few respondents admitting to experience with home modification.

**4. Results**

The general characteristics of respondents are shown in Table 2. Of the total 148 participants, 84 respondents (58.7%) were aged under 55, and 59 (41.3%) were aged over 56. Regarding types of vision impairment, 87 respondents (61.3%) were blind and 55 (38.7%) had low vision. Respondents who perceived health conditions as being bad were 42% of the total. More than half of respondents (58%) considered their health to be "not bad" or "good." Regarding housing type, 44.8% of respondents lived in an apartment and 55.2% lived in either single or multi-family housing.
Individuals were asked if they had experienced accidents and falls. About 42% of respondents replied that they had experienced one or more accidents in their homes, with about one-third of participants (29.7%) reporting that they had fallen in their home.

Table 3. Cause of Accidents (including duplicates)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Younger</th>
<th>Older</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f</td>
<td>%</td>
<td>f</td>
</tr>
<tr>
<td>Dark</td>
<td>11</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Narrow Pathway</td>
<td>8</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Floor Mat</td>
<td>9</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Water on the Floor</td>
<td>10</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Clutter on the Floor</td>
<td>12</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Cords</td>
<td>8</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Steep Slope</td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Floor Level Difference</td>
<td>14</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Threshold</td>
<td>15</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>Others</td>
<td>7</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
<td>64</td>
<td>100</td>
</tr>
</tbody>
</table>

Respondents gave 130 individual reasons as to the causes of accidents, and the top 11 are shown in Table 3. For the younger group, the main causes, in order of frequency, were "clutter on the floor" (16.5%), "threshold" at 15 (15.5%), "floor level difference" at 13 (13.4%), and "crashing" at 12 (12.4%). For the older group, "floor level difference" (16.8%) was the most frequently cited reason, followed by "crashing" (15.7%), and "clutter on the floor" and "water on the floor" (10.8% each).

Table 4. displays descriptive statistics and results of chi-square analyses conducted to compare environmental demand on the dependent variables (falls or accidents). More than half of the HED group (61.7%) experienced accidents in their homes, compared with only 32.7% of the LED group; thus, there was a significant difference in the experience of accidents between these two groups (x² = 10.999, p = 0.001).

A significant difference can be seen in the frequency of falls between the high and low environmental demand groups (x² = 8.067, p = 0.005). People living in more difficult housing environments were more likely to have a higher number of fall experiences than people living in housing without difficulties.

Other than the degree of falls and accident experiences, there is no significant individual difference between the HED group and the LED group.

Table 5. Difference in Experience of Accidents between HED and LED

<table>
<thead>
<tr>
<th>Variable</th>
<th>HED</th>
<th>LED</th>
<th>Total</th>
<th>x² (contingency coefficient)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger (n=84)</td>
<td>57.4(27)</td>
<td>59.4(57)</td>
<td>58.7(84)</td>
<td></td>
</tr>
<tr>
<td>Older (n=59)</td>
<td>42.6(20)</td>
<td>40.6(39)</td>
<td>41.3(59)</td>
<td></td>
</tr>
<tr>
<td>Type of vision impairment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blind (n=90)</td>
<td>67.3(33)</td>
<td>58.2(57)</td>
<td>61.2(90)</td>
<td>n.s</td>
</tr>
<tr>
<td>Low vision (n=57)</td>
<td>32.7(16)</td>
<td>41.8(41)</td>
<td>38.8(57)</td>
<td>n.s</td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad (n=60)</td>
<td>44.9(22)</td>
<td>38.4(38)</td>
<td>40.5(60)</td>
<td>n.s</td>
</tr>
<tr>
<td>Not bad or Good (n=88)</td>
<td>55.1(27)</td>
<td>61.6(61)</td>
<td>59.5(88)</td>
<td>n.s</td>
</tr>
</tbody>
</table>

=x <0.01, n.s.= non-significant

Regarding the influence of environmental demand on accidents, personal characteristics such as age, type of sight loss, health condition, and housing type can also affect the chance of accidents; therefore, a further chi-square test was conducted (Table 5.).

For the elderly group, housing conditions have a greater influence on the probability of accidents (i.e., statistically significant). Among elderly participants, 80% of respondents in the HED group had experienced accidents in their homes, compared with only 33% of respondents in the LED group (x² = 11.520, p = 0.001). For the older adults, the contingency coefficient value (0.404) is nearly equal to 0.447, which shows that the
degree of relationship between accident experience and environmental demand is high, as is the association of dependence of the classifications in the frequency table. For the younger group, the difference between HED and LED is not significant.

Frequency differences existed among the number of respondents who experienced accidents according to their type of vision impairment, health condition, and housing type. For those with low vision, effects of housing conditions appeared to be more significant, as the frequency of accidents of respondents with low vision was higher when living in a high-demand environment than when living in a low-demand environment ($\chi^2 = 11.196, p = 0.001$). For the blind, accident experience did not differ under the two different housing conditions, though under the low environmental demand condition, blind people had more accidents than people with low vision ($\chi^2 = 5.059, p = 0.024$).

Regardless of health condition, people in HED had more accidents than people in LED. Overall, however, people with bad health had a higher percentage of accident experience than people with good health. This finding underlines the importance of environmental effects because these effects are significant for both groups, though they are more influential in people with a bad health condition.

Regardless of housing type, people in the HED group experienced more accidents in their homes, though group differences do exist between HED and LED respondents.

Further chi-square analyses revealed significant influences of environmental demand on fall experience on the basis of individual characteristics such as age, type of sight loss, health condition, and housing type (Table 6).

For elderly people, 50% of respondents in the HED group experienced falls, compared with only 20.5% of respondents in the LED group ($\chi^2 = 5.422, p = 0.020$). For older adults with vision impairment, housing conditions were more important in reducing falls within the home.

For the blind, there was no difference between HED and LED respondents; however, for people with low vision, the frequency of fall experience was significantly different ($\chi^2 = 19.502, p = 0.000$). People with low vision can rely on their remaining visual perception, so housing conditions can be more influential to their quality of life. For people with low vision, the contingency coefficient value (0.505) is higher than 0.447, which indicates that the degree of relationship between fall experiences and environmental demand is strong.

A separate chi-square analysis was conducted within LED, and revealed that the blind (90.5%) had more accidents than people with low vision ($\chi^2 = 11.468, p = 0.001$), and that these falls were less affected by environmental conditions.

For the people who perceived their health condition as bad, the frequency of falls was significantly different between those in the HED group and those in the LED group ($\chi^2 = 10.048, p = 0.002$). For people with a bad health condition, the contingency coefficient value (0.379) is higher than 0.287, which shows that the degree of relationship between fall experiences and environmental demand is moderate. People who perceived their health condition as not bad or having good health had less experience with falls than people with bad health conditions. In general, it was found that when health conditions are bad, the effect of environmental conditions on falls is more significant.

People in the HED group with bad health had more experience with falls (68.2%) than people with good health ($\chi^2 = 8.749, p = 0.003$). When health conditions are not bad or good (25.9%), the negative effects of environment on the person decreased.

Group differences existed between apartment dwellers in HED and LED ($\chi^2 = 5.209, p = 0.022$). Although the group difference is not significant in single/multi-family housing residents, people in the HED group had more frequent falls.

The significance of difference in effect of health condition and environmental demand on life satisfaction or modification intention was assessed with a t-test. When the health condition is good, the mean of

Table 6. Difference in Experience of Falls between HED and LED

<table>
<thead>
<tr>
<th></th>
<th>HED &amp;</th>
<th>LED &amp;</th>
<th>Total</th>
<th>$\chi^2$ (contingency coefficient)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger (n=84)</td>
<td>44.4(12)</td>
<td>26.4(14)</td>
<td>31.0(26)</td>
<td>n.s.</td>
</tr>
<tr>
<td>Older (n=59)</td>
<td>50.0(10)</td>
<td>20.5(8)</td>
<td>30.5(18)</td>
<td>5.422***</td>
</tr>
<tr>
<td><strong>Type of vision impairment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blind (n=90)</td>
<td>39.4(13)</td>
<td>33.3(19)</td>
<td>35.6(32)</td>
<td>n.s.</td>
</tr>
<tr>
<td>Low vision (n=57)</td>
<td>56.3(9)</td>
<td>4.9(2)</td>
<td>19.3(11)</td>
<td>19.502***</td>
</tr>
<tr>
<td><strong>Health condition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad (n=60)</td>
<td>68.2(15)</td>
<td>26.3(10)</td>
<td>41.7(25)</td>
<td>10.048***</td>
</tr>
<tr>
<td>Not bad or Good (n=88)</td>
<td>25.9(7)</td>
<td>19.7(12)</td>
<td>21.6(19)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Housing Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apartment (n=65)</td>
<td>47.1(8)</td>
<td>18.8(9)</td>
<td>26.2(17)</td>
<td>5.209***</td>
</tr>
<tr>
<td>Single/multi-family housing (n=83)</td>
<td>43.8(14)</td>
<td>25.5(13)</td>
<td>32.5(27)</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

* = p < 0.05, ** = p < 0.01, *** = p < 0.001, n.s. = non-significant

Table 7. Modification Intention and Life Satisfaction Difference

<table>
<thead>
<tr>
<th></th>
<th>HED &amp; Bad Health</th>
<th>LED &amp; Bad Health</th>
<th>HED &amp; Good Health</th>
<th>LED &amp; Good Health</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modification Intention</strong></td>
<td>3.10</td>
<td>2.56</td>
<td>2.77</td>
<td>2.05</td>
<td>8.837***</td>
</tr>
<tr>
<td><strong>Life Satisfaction</strong></td>
<td>2.76</td>
<td>2.95</td>
<td>3.12</td>
<td>3.36</td>
<td>3.242**</td>
</tr>
</tbody>
</table>

* = p < 0.05, ** = p < 0.01, *** = p < 0.001
life satisfaction is higher and the mean of modification intention is lower. When the environmental demand is low, the mean of life satisfaction is higher and the mean of modification intention is lower.

Results support the assumption that the level of disparity becomes greater when people are under higher environmental demands and bad health conditions (Table 7. and Fig.2.). People with good health and low environmental demands rated their life satisfaction higher (3.36) and modification intention lower (2.05) than people with a bad health condition and high environmental demand.

Considering this result, we conducted Duncan's multiple range test to identify significance levels for the difference between groups. The level of life satisfaction is significantly different between three groups: (1) respondents with bad health condition and high environmental demand, (2) respondents with bad health condition and low environmental demand and respondents with good health condition and high environmental demand, and (3) respondents with good health condition and low environmental demand. The level of modification intention is also significantly different between the four groups.

The results of the hierarchical regression analysis to test the strength and direction of relationships between several predictor variables and modification intention are presented in Table 8.

Table 8. Multiple Regression Results for Life Satisfaction

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step 1</th>
<th></th>
<th>Step 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Beta</td>
<td>T</td>
<td>B</td>
</tr>
<tr>
<td>Constant</td>
<td>.912</td>
<td>2.832**</td>
<td>2.187</td>
<td>4.707**</td>
</tr>
<tr>
<td>Risk</td>
<td>.144</td>
<td>.140</td>
<td>1.232</td>
<td>.139</td>
</tr>
<tr>
<td>Difficulties</td>
<td>.333</td>
<td>.288</td>
<td>3.225**</td>
<td>.271</td>
</tr>
<tr>
<td>Difficulties Using Objects</td>
<td>-.099</td>
<td>-.117</td>
<td>-.121</td>
<td>-.102</td>
</tr>
<tr>
<td>Lighting Conditions</td>
<td>.216</td>
<td>.241</td>
<td>2.806**</td>
<td>.203</td>
</tr>
<tr>
<td>Indoor Environment</td>
<td>.007</td>
<td>.009</td>
<td>.097</td>
<td>-.010</td>
</tr>
<tr>
<td>Life Satisfaction</td>
<td>-.177</td>
<td>-.166</td>
<td>-.204**</td>
<td></td>
</tr>
<tr>
<td>EDxHealth Condition</td>
<td>-.171</td>
<td>-.200</td>
<td>-.2352**</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.275</td>
<td></td>
<td></td>
<td>.355</td>
</tr>
<tr>
<td>F</td>
<td>8.433***</td>
<td></td>
<td></td>
<td>8.558***</td>
</tr>
</tbody>
</table>

*p < 0.05, ** = p < 0.01, *** = p < 0.001

In the first step, environmental demands to predict modification intention were assessed by entering risk, difficulties in daily life difficulties using objects, lighting conditions, and indoor environment conditions into the model. As a result, the regression model indicated that difficulties in daily life and lighting conditions were significant predictors. Respondents with fewer difficulties in living conditions and better lighting conditions showed less modification intention.

The predictor variables entered in the first step were able to explain 27.5% (p = 0.001) of the variance in modification intention. When ED (environmental demand) × health condition and life satisfaction were added to this model in step 2, both ED × health condition and life satisfaction were found to be significant indicators of modification intention. The addition of ED × health condition and life satisfaction in step 2 resulted in an 8% (p = 0.001) improvement in explained variance. Overall, this model accounted for 35.5% (p = 0.001) of the variance in modification intention.

The results also emphasized that lighting is a significant indicator of modification intentions for people with sight loss. This finding is consistent with previous studies that revealed that the effects of lighting on ADL were significant (Brunnstrom et al., 2004), and that proper lighting adaptation and design could eradicate basic problems of living, including falls, and lead to more independent and active lives (Slater, 2008).

The results of the hierarchical regression analysis to test the effects of environmental demands on life satisfaction are shown in Table 9. In the first step, environmental demand variables were assessed to predict life satisfaction; however, these variables did not explain a significant amount of the variance in life satisfaction. After entering ED × health condition and modification intention in step 2, both ED × health condition and life satisfaction were found to be significant predictors of life satisfaction. The beta weight for modification intention was negative, indicating that respondents with less modification intention reported more satisfaction with life than did respondents with more modification intention.

The effect for ED × health condition was positive, suggesting that respondents with better individual health condition and lower environmental demand experienced greater life satisfaction as compared to those respondents with bad health condition and higher environmental demand. The overall regression model was able to explain 14.2% (p = 0.001) of the variance in life satisfaction.

5. Discussion

This study employed the person-environment fit model to investigate the relationships among environmental conditions, personal characteristics, and both accidents and falls. In addition, the study
examined whether physical environmental demand influenced negative behavioral outcomes, such as accidents and falls, and the fit or disparity between environmental demands of the visually impaired and individual characteristics regarding differences in accident occurrence and housing modification intention. We hypothesized that higher accident and fall occurrence would be found in the HED group, and that when they have lower individual capabilities such as old age, bad health conditions, or no vision, the consequences of environmental demand would be more influential.

The findings of this study show that when living in more difficult and inconvenient housing (HED), accidents and falls occurred more frequently in those living with vision impairment. The main causes of accidents found during this study were "floor level difference," "clutter on the floor," "crashing," and "threshold"—all primarily related to housing structure and finishing methods. The findings attest to the practical importance of housing conditions for visually impaired people and that specific guidance is necessary.

The findings of this study differ from previous studies in that the effects of difficult and inconvenient housing appear to be more significant to people with low vision than to people with no vision. The frequency of accidents and falls was significantly different for people with low vision living in a high-demand environment versus a low-demand environment. It seems that the effects of housing conditions are stronger for more vigorous people with low vision compared to the blind, who are less likely to engage in various household chores and, thus, are not exposed to as many hazards. For people with no vision, there is no difference between living in HED or LED conditions. Since people with low vision can rely on their remaining visual perception, housing condition can be more influential to their quality of life. This interpretation is consistent with previous findings (Steinman, 2009; Wahl et al., 1999).

In addition, the impact of negative environmental conditions is more significant to people with bad health conditions. In the HED group, people with bad health experienced more falls than people in the HED group who had good health.

Results strongly supported the conceptual model proposed, as when a greater disparity between environmental demands and personal capability occurs, the more negative behavioral outcomes—including accidents and falls—were generated. While much prior research on falls has focused solely on older people (Stevens, Holman, & Bennet, 2001; Chang et al., 2004; Costello & Edelstein, 2008), to be more specific, this study dealt with housing accidents and falls among the visually impaired across a variety of age groups.

Few studies have been conducted to investigate how environmental conditions and hazards in the homes of people with vision impairments result in accidents or falls. Since the consequences of fall accidents would include multiple risk factors affecting substantial disability, morbidity, and mortality for the elderly (Fletcher & Hirdes, 2002), many studies have investigated risk factors of homes and prevention strategies regarding falls (Steinman et al., 2009; Stevens et al., 2001). Fletcher & Hirdes (2002) reported that when seniors had more environmental hazards within their homes, they were 1.2 times more likely to experience falls.

People with vision impairment, which has a higher prevalence among the elderly, could face an increased possibility of accidents and falls in their homes. It is noteworthy that accidents and falls could occur due to common risk factors in homes, and that some intervention and strategies could be applied to mainstream housing options, as well as some forms of specialist provisions.

Accidents and fall experiences could be associated with fear of and withdrawal from daily activities; therefore, it is important to reduce the occurrence of accidents and falls for visually impaired people by ensuring a balance between individual competence and the level of environmental demand.

Environmental demands may not always be effective as predictors of modification intention, but rather are defined as contributing factors. In combination with personal characteristics and individual variables, environmental characteristics influenced the degree of "fit," or congruence, which resulted in different behavior outcomes such as modification intention.

One of the limitations in this study would be that the operational concept of environmental demand was proposed and tested exclusively for this study, as there was no commonly recognized measure for environmental demand (Edwards et al., 2006; Lawton, 1983).

In addition, since the perceived inconveniences or difficulties could be abstract and conceptual with wide variations in housing conditions, living culture, unique housing structure, and individual characteristics, among other factors, there remains the question of how to intervene and then alleviate or remove specific inconveniences or difficulties in the home.

Despite these limitations, this study aimed to contribute relevant evidence, emphasizing that housing conditions and physical environment can significantly influence the experience of accidents and falls, and raise the important consideration of intervention or strategies to reduce risk factors in homes.
Acknowledgement

This research was supported by a grant from the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HI13C2252).

Note

1 Values of the contingency coefficient for "small," "medium," and "large" effect size are as follows: (1) small effect size: \( c = 0.100 \); (2) medium effect size: \( c = 0.298 \); (3) large effect size: \( c = 0.447 \) (Cohen, 1988, p.222-225).

References