Development of the Korean Health Behavior for Dementia Prevention Scale for Older Adults

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Purpose: This study aimed to develop the Korean Health Behavior for Dementia Prevention Scale (K-HBDP) and test its validity and reliability. Methods: In this methodological study, the K-HBDP scale was administered to 216 community-dwelling older adults (aged 65 or older) in 2020 in seven cities of western Korea using convenience sampling. Item analysis, construct validity, item convergent and discriminant validity, criterion validity, and internal consistency reliability were evaluated using SPSS for Windows 27.0. Results: The scale includes 23 items and five subscales: cognitive social activities, healthcare management, lifestyle, smoking and drinking, and eating habits, and the cumulative variance explained by the factors was 66.8%. Cronbach’s α for internal consistency of the total scale was .90 and ranged from .65 to .89 for all subscales. Item convergent and discriminant validity of the K-HBDP were confirmed. Criterion validity was demonstrated with the Health Promoting Lifestyle Profile-II. Conclusion: The findings suggest that K-HBDP scale can be used to measure healthy activities to prevent dementia in older adults. The use of this tool is expected to help develop interventions, educational materials, and training programs to improve nursing practice.

Key Words: Alzheimer disease; Dementia; Factor analysis; Health behavior; Validation study
INTRODUCTION

Dementia is one of the most highlighted policy concerns in the field of public healthcare and has become a markedly high priority worldwide. In South Korea, the number of patients with dementia soared alongside a rapid increase in its elderly population. Dementia among the older adults aged 65 or older is estimated to be 10.3% in Korea in 2020, and it is expected to increase to 15.9% by 2050[1].

To enhance the quality of life in senescence, psychological health—especially the risk of cognitive impairment—should be accounted for as an important factor in physical health. The pathogenesis (cause) of dementia remains unclear and a complete cure is still unavailable. With an increased focus on preventing dementia, the World Health Organization (WHO) has emphasized the development of strategies to promote lifestyle, control cardiovascular diseases, and pursue psychological healthcare management [2]. In various countries, dementia prevention measures have been developed and recommended to the public, based on findings by previous literature reviews and survey data on common factors of dementia prevention [3-5]. Further, the Ministry of Health and Welfare in South Korea has developed measures to include lifestyle improvement, disease management, close human relationships, and differential diagnoses of dementia [6].

Previous studies on behaviors related to dementia prevention showed that individuals with higher degrees of knowledge and positive attitudes about dementia performed more actively on the prevention of dementia [7,8]. In addition, physical and social activities, diet, obesity, smoking, diabetes, depression, and education level were reported as related to dementia prevention and hence, as factors influencing dementia [9,10]. However, few studies have investigated the precise level of dementia prevention using a systematic measurement tool.

The most frequently used tool to measure behavior preventing dementia in older adults in South Korea is the Prevention of Dementia questionnaire developed by Lee et al. [11] based on dementia prevention research. Another tool developed by Lim et al. [12] consists of 15 questions based on the findings of literature reviews. The reliability of this tool was verified using the Delphi method. Many other studies used dementia prevention measures suggested by the Ministry of Health and Welfare and the National Institute of Dementia (NID). However, only their content validity was verified by a specialist in the field. To illustrate, Yu [13] developed a tool comprising three questions based on dementia prevention measures that were suggested by the Ministry of Health and Welfare. On the other hand, Park [14] developed a tool that comprised 18 questions based on the Dementia Prevention 333, suggested by the Ministry of Health and Welfare and the NID. Meanwhile, Kim and Yang [15] used 15 questions to measure dementia prevention, while overseas in Australia, the Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction Scale (MCL HB-DRR) was developed [7], which comprised 27 questions and was developed in a study of 659 Australians, to measure intentions towards preventing dementia.

Hence, most dementia prevention tools developed in Korea have been used without validity or reliability verified through systematic tool development procedures. These instruments have also been arbitrarily constructed, based either on certain dementia prevention measures or the researcher’s own knowledge, thus posing limitations. MCL HB-DRR developed and used in Australia consists of questions that measure individual beliefs about health behaviors for dementia risk reduction rather than specific dementia prevention behaviors [7]. In addition, there is a problem of having some limitations due to cultural or lifestyle differences in the contents recommended as a dementia prevention guide in the United Kingdom or the United States. Therefore, the authors intend to develop an effective and reliable measure for the prevention of dementia, focusing on actions that can be easily understood and practiced by the older adults in Korea. Through this, it was considered that it would contribute to future intervention or research on dementia prevention in the older adults.

METHODS

1. Study Design

This study was a methodological study to develop a Korean Health Behavior for Dementia Prevention (K-HBDP) scale for older adults and to verify its validity and reliability.

2. Setting and Sample

Data collection was performed during the period from April to June 2020. Based on the nationwide distribution of older adults, as estimated by Statistics Korea in 2018, older adults (aged 65 years or older) were recruited from seven senior community centers located in seven provinces and cities in the western regions of South Korea, through quota sampling.

First, the researchers attached the recruitment notice for
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The sample size for EFA was enough. Because there were 216 individuals in this study, factor analysis can be performed with a sample size of more than the number of factors. Furthermore, when there are high correlations between items and well-defined factors, factor analysis (EFA) is 200 samples, which is 5–20 times more than the number of measured variables and 20 times greater than the number of factors. The absolute minimum sample size for exploratory factor analysis (EFA) is 200 samples, which is 5–20 times more than the number of measured variables and 20 times greater than the number of factors. Furthermore, when there are high correlations between items and well-defined factors, factor analysis can be performed with a sample size of 200 [16]. Because there were 216 individuals in this study, the sample size for EFA was enough.

3. Measurement

The Health Promoting Lifestyle Profile-II (HPLP-II) created by Walker et al. [17] was used to test criteria validity. Based on previous studies suggesting that the use of effective health promotion behavior positively influenced the cognitive functions of the older adults. The HPLP-II is widely used as a gold standard tool to measure health promotion behaviors [18,19]. And the HPLP II Korean version was a measure that has established validity and reliability [20]. The scale is divided into six subscales, each with 52 items: health responsibility, physical activity, nutrition, spiritual growth, interpersonal relations, and stress management. The items are scored on a four-point Likert scale, with higher scores indicating more health-promoting behaviors. Cronbach’s α was .92 for the overall scale and .70–.90 for the subscales in the original study [17]. Cronbach’s α was .92 overall and .78–.92 for the subscales in the current study.

4. Ethical Considerations

Written approval was obtained from the affiliated university (IRB No. JBNU 2020-01-002). Participants were informed that the contents of the questionnaire were to be used solely for research purposes, that the data were to be coded for privacy protection and that all data would be discarded after a year. The questionnaire took approximately 15–20 minutes to complete.

5. Instrument Development

1) Item generation

Through a literature search, all studies published within the last five years among master’s and doctorate degree dissertations and academic journals were searched. Data search was performed using the National Digital Science Library, Research Information Sharing Service, the Korean Studies Information Service system, and the Database Periodic Information Academy and dementia prevention behaviors recommended by WHO [2], NHS (National Health Service) [3], and NID [4]. A total of 54 articles were reviewed by searching the literature with the keywords of "dementia prevention behavior", "dementia and prevention", and "older adults". A total of 48 items were extracted. Through the consultation of two professors of nursing and a discussion among the investigators, the items with high levels of discrimination were selected, as follows: 11 for lifestyle, 3 for participation in social activities, 2 for self-development, 9 for healthcare management, and 4 for cognitive training. This added up to 29 preliminary items.

2) Content validity

The content validity of the first set (29 preliminary items) was tested by a panel of specialists (four nursing professors with extensive experience in tool development, one hospice specialist, and one geriatric and dementia specialist). Opinions were collected regarding any incomprehensible sentences, ambiguous expressions, or words that were difficult to interpret, as well as further questions that needed to be added. The agreement of panel members was estimated using the item-level content validity index (I-CVI) and scale-level content validity index (S-CVI/Ave). The content validity of an item was determined as suitable for selection if the score of the I-CVI was ≥ .78 and the S-CVI/Ave was ≥ .90 [21]. The following 3 items were re-
moved due to an I-CVI < .80: ‘Do you discuss what to do when you have dementia with your family?’; ‘Do you check your blood pressure, blood glucose and blood cholesterol periodically?’; ‘Do you sleep at least 7~8 hours per day?’ In addition, based on the specialists’ opinion that 6 items overlapped, 2 items on conversations with family, 2 items on chronic disease management, and 2 items on participation in social activities were combined as 1 item each. Further, an item was added based on the specialists’ opinion: ‘Do you often include blue-backed fish in your diet?’ Thus, the second set of preliminary items had 24 rearranged items.

3) Pilot test

A pilot test was carried out to ensure the applicability of the 24 questions produced from the content and face validity. The pilot test took place on April 13th and 17th, 2020. The purpose of the pilot test is to identify and fix any potential challenges, such as difficult-to-understand vocabulary. The average age of the ten older persons was 70.9 years (range: 65~89 years). Six of the participants were women, while the other four were men. All of the participants were born in Korea, speak Korean as their first language, and can read and write Korean. Seven of them had completed elementary school. In addition, opinions on reaction times, items that were difficult to understand, and those that needed further explanation were gathered. Based on the results, the 2 items that were reported as being confusing were revised and 1 item (‘Do you take health supplements to prevent dementia?’) that was reported to be ambiguous was removed. Thus, 23 items remained. In addition, the items were evaluated on a 4-point Likert scale ranging from 1 (Very inappropriate) to 4 (Very appropriate), regarding aspects such as sentence comprehension, font size, item arrangement, and length. In addition, the mean response time for each item of the questionnaire was 15~20 mins.

6. Statistical Analysis

Data were analyzed using SPSS/WinDow Version 27.0. For item analysis, the mean, standard deviation, range, ceiling effect, floor effect, skewness and kurtosis, and corrected item-total correlation coefficients were estimated. Correlation coefficients for the item scores and total scores were obtained. Cronbach’s $\alpha$ of .70 is considered sufficient. EFA was performed to test the construct validity of the tool. The Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity tests were performed to confirm the suitability of the tool. For rotation, the Varimax method was used. Multi-trait multi-item matrix analysis was used to examine the convergent and discriminant validity of K-HBDP items. Item’s convergent validity was judged satisfied in multi-trait multi-item matrix analysis if correlation coefficients with subscales to which each item belongs are .40 or greater [22]. Item’s discriminant validity was determined to be satisfied if no item has a higher value than correlation coefficients with other subscales to which each item does not belong, and if the difference between the correlation coefficients of each item and its subscales and the correlation coefficients with other subscales is greater than 2 times the standard error of correlation coefficients [22]. In addition, because Cronbach’s $\alpha$ coefficients for each subscale were greater than the correlation coefficients for the other subscales [23], the item’s discriminant validity was proven. The Pearson correlation coefficients for correlations between the subscales of the K-HBDP and the subscales of the HPLP-II were used to examine criterion validity. Criterion validity is supported by sufficiently high correlations (r = .40 to .80) between related scales [24]. Statistical significance was defined as a $p$-value of less than .05.

RESULTS

1. Participants’ Characteristics

A total of 216 older adults were included in the study. The participants’ average age was 73.37 years (range 65~89). The majority of participants (78.9%) were women, with 63.4 percent having spouses, 64.8 percent living with family, and 30.6 percent having completed primary education (Table 1).

2. Item Analysis

The mean score was 1.29~3.16 for the 23 items. Although EFA does not require the assumption of normality itself, it is also desirable to examine the other characteristics of the measurement variables through skewness and kurtosis [25]. The skewness of each item ranged between -0.61~2.65 and the kurtosis ranged between -1.21~6.33, item 7 (smoking-related item) being the highest. The ceiling effect ranged between 1.4% and 8.8%, which was lower than the acceptable limit of 15.0%; however, the floor effect ranged between 0.5~59.2%, with the smoking and drinking-related factor exceeding the criteria. This implies that the question, due to its inherent characteristics, inevitably induced a skewed response. As smoking is an important risk factor in developing dementia [26] and moderate drinking is strongly recommended to prevent dementia [26], this
The initial EFA was performed on 23 items whose suitability was confirmed through item analysis. The EFA using an eigenvalue curve indicated five eigenvalues in the scree plot above the mean; these five subfactors were retained. In addition, the factors showing ≥ 60.0% cumulative percentage of the distribution that was accounted for by the variables were selected at factor loading ≥ .50. The value of KMO was .87, which satisfied the general criteria of ≥ .70. Further, the result of Bartlett’s sphericity test showed statistical significance (p < .001). Thus, the Varimax rotation and the principal components analysis (PCA) were used for factor extraction to derive five subfactors from 23 questions. We used the PCA as a factor extract model, which is primarily used to minimize information loss with the least number of factors aiming at the forecast, and we used Varimax rotation to classify the factors by maximizing the sum of factor loading variance and clearing the factor property to the greatest extent possible. The cumulative explanatory variance was 66.8% and all 23 items had eigenvalues ≥ 1.0, at a factor loading between .53~.88 to satisfy the criteria. And also, the commonality was .48~.83, with item 14 showing a score slightly lower than .50. Due to exercise being reported in previous studies as a critical factor in preventing dementia [5,27], it was retained for the analysis (Table 3).

Each subfactor was named based on the item with the highest factor loading and the conceptual framework. For Factor 1, the item with the highest loading was item 18. Along with the six items (17, 19, 20, 21, 22, and 23) was 18.9%. For Factor 2, the explanatory power of six items (1, 2, 3, 4, 5, and 6) was 18.0%. For Factor 3, the explanatory power of the five items (12, 13, 14, 15, and 16) was 13.4%. For Factor 4, the explanatory power of the two items (7 and 8) was 8.4%. For Factor 5, the explanatory power of the three items (9, 10, and 11) was 8.1%. Accordingly, Factor 1 was called cognitive social activities, Factor 2 was healthcare management, Factor 3 was lifestyle, Factor 4 was smoking and drinking, and Factor 5 was eating habits (Table 3).

### 4. Convergent and Discriminant Validity of K-HBDP Items

The item–subscale correlation corrected for overlap for coefficients ranged from .40 to .82 in this study, with all of them being .40 or higher. The item’s convergent validity was established (Table 4). The convergent and discriminant validity of K-HBDP items were tested using a multi-trait multi-item matrix analysis. The results showed that the correlation coefficient between 23 items and the subscales to which each item belongs spans from .40 to .82, with all of them being .40 or above, indicating that the item’s convergent validity was 100% successful. In the item’s discriminant validity, the correlation coefficient with other subscales to which each item does not belong ranges from .00 to .53, and no item has a value greater than the correlation coefficient compared to the factor to which each item belongs, and while it can be considered that the discriminant validity of the item is established if the difference between the correlation coefficients of each item and its subscales and the correlation coefficients with other subscales and the correlation coefficients with other subscales and the correlation coefficients with other. Furthermore, each subscale’s Cronbach’s α coefficients were

| Table 1. General Characteristics of Participants (N=216) |
|-----------------------|------------------------|------------------|
| Characteristics       | Categories             | n (%) or Mean±SD |
| Age (year)            | 65–69                  | 88(40.4)         |
|                       | 70–79                  | 80(36.7)         |
|                       | ≥ 80                   | 48(22.9)         |
|                       |                       | 73.37±7.50       |
| Gender                | Men                    | 44(21.1)         |
|                       | Women                  | 172(78.9)        |
| Presence of a spouse  | Had a spouse           | 137(63.4)        |
|                       | Did not have a spouse  | 79(36.6)         |
| Family type           | Alone                  | 76(35.2)         |
|                       | Living together        | 140(64.8)        |
| Religion              | Yes                    | 147(68.1)        |
|                       | No                     | 69(31.9)         |
| Education level       | Uneducated             | 31(14.4)         |
|                       | Elementary school      | 66(30.6)         |
|                       | Middle school          | 42(19.4)         |
|                       | High school            | 49(22.6)         |
|                       | ≥ College              | 28(13.0)         |
| Economic level        | ≥ Middle-high          | 81(37.5)         |
|                       | Middle-low             | 83(38.4)         |
|                       | Low                    | 52(24.1)         |
| Health condition      | Good                   | 36(16.7)         |
|                       | Normal                 | 138(63.9)        |
|                       | Poor                   | 42(19.4)         |

M=mean; SD=standard deviation.
higher than the correlation coefficients among the other subscales. Thus, the features of each subscale were proven to be distinct. Therefore, the item discriminant validity success rate was also 97.4% (Table 4).

**5. Criterion Validity**

To test criterion validity, the HPLP-II was used to analyze correlations with the tool developed in this study. All five subfactors showed a positive correlation with the total score of the HPLP-II with statistical significance: healthcare management ($r=.68$, $p < .001$), cognitive social activities ($r=.77$, $p < .001$), lifestyle ($r=.59$, $p < .001$), eating habits ($r=.39$, $p < .001$), and smoking and drinking ($r=.18$, $p = .004$).

**6. Reliability of the Scale**

The tool comprises of 23 items and shows a Cronbach’s α of .90. For each subcategory, Cronbach’s α measured at .89 for cognitive social activities, .89 for healthcare management, .81 for lifestyle, .82 for smoking and drinking, and .65 for eating habits. The total score was 54.68±11.17 out of 92 (Table 2).

**DISCUSSION**

This study was conducted to develop a tool that measures behaviors preventing dementia in older adults and verifying its validity and reliability. The final tool, the K-HBPDS, comprises of five subfactors and 23 items. To en-
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Sure content validity, six investigators reviewed previous studies on dementia through 15 regular meetings before the tool development. After the items were developed, six specialists reviewed the content validity.

The EFA was performed to test construct validity. Based on the literature review and an analysis of the conventional tools, the Prevention of Dementia tool was shown to comprise three factors: healthcare management, lifestyle, and cognitive social activities [11,13]. However, in this study, the EFA led to the extraction of five subfactors. The cumulative distribution of the five subfactors was 66.8%, while the explanatory distribution of each factor was as follows: 18.9% for Factor 1, 18.0% for Factor 2, 13.4% for Factor 3, 8.4% for Factor 4, and 8.1% for Factor 5. The items constituting Factors 1 and 2 addressed general activities to prevent dementia. The larger number of items, in comparison to other factors, caused the distribution to show a slightly higher trend, but as the distribution was mostly balanced, each factor was determined to have an appropriate number of items.

The seven questions assigned to Factor 1 in the EFA measure cognitive social activities. The components are hands use, reading, self-development, search for dementia information, memory training, social activity, and contact with family or friends. The Prevention of Dementia tools [11,13] comprise of items related to reading and social activities. In a cohort study that was conducted on 33,152 older Japanese adults [28], the incidence of dementia could be lowered if an individual had social interactions with family or friends and participated in local community activities. In addition, the risk of dementia decreased through reading, hand activities, puzzle solving, social activity par-

### Table 3. Factor Loadings from Exploratory Factor Analysis

| Factors  | Items        | I               | II              | III             | IV               | V               | Communality |
|----------|--------------|-----------------|-----------------|-----------------|------------------|-----------------|-------------|
|          | Items        | Cognitive social activities | Healthcare management | Lifestyle | Smoking and drinking | Eating habits |
| I        | Item 17      | .61             | .33             | .26             | -.17             | .25             | .64         |
|          | Item 18      | .81             | .20             | .13             | .11              | -.01            | .73         |
|          | Item 19      | .77             | .17             | .14             | .26              | -.10            | .72         |
|          | Item 20      | .78             | .06             | .09             | -.02             | .24             | .68         |
|          | Item 21      | .75             | .18             | .20             | -.13             | .26             | .71         |
|          | Item 22      | .77             | .20             | .14             | .04              | .01             | .65         |
|          | Item 23      | .53             | .44             | .15             | .03              | -.08            | .51         |
| II       | Item 1       | .15             | .80             | .23             | .01              | .09             | .73         |
|          | Item 2       | .15             | .86             | .26             | -.05             | .02             | .82         |
|          | Item 3       | .10             | .78             | -.05            | .06              | -.00            | .63         |
|          | Item 4       | .35             | .68             | -.03            | .01              | .17             | .62         |
|          | Item 5       | .27             | .61             | .24             | -.11             | .32             | .61         |
|          | Item 6       | .20             | .78             | .32             | -.03             | .07             | .75         |
| III      | Item 12      | .14             | .24             | .74             | .10              | .10             | .64         |
|          | Item 13      | .08             | .08             | .82             | -.07             | -.02            | .70         |
|          | Item 14      | .33             | .08             | .56             | .09              | -.22            | .48         |
|          | Item 15      | .07             | .11             | .79             | .04              | -.10            | .65         |
|          | Item 16      | .30             | .18             | .62             | -.07             | .14             | .54         |
| IV       | Item 7       | -.01            | -.11            | .00             | .88              | .20             | .83         |
|          | Item 8       | .12             | -.03            | .08             | .85              | .18             | .78         |
| V        | Item 9       | .37             | .32             | .17             | .02              | .62             | .65         |
|          | Item 10      | -.03            | -.05            | -.14            | .43              | .65             | .63         |
|          | Item 11      | .09             | .16             | -.09            | .25              | .75             | .68         |

Kaiser-Meyer-Olkin (KMO) = .87; Bartlett’s test of sphericity $\chi^2=2,707.09 \ (p < .001)$

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**Korean Medical Association**
29(3), 2022년 8월

https://doi.org/10.7739/jkafn.2022.29.3.363 369
participation, painting, cooking, and playing musical instruments [29]. In a longitudinal study that was conducted on 880 females, the group performing cognitive activities showed a reduced risk of dementia by 0.66 times compared to the control group [27]. These results lent support to the idea that the effects of dementia prevention may be obtained through various cognitive and social activities that allow brain cells to be activated, as well as through activities involving hand movements allowing synaptic networks to be formed or reinforced [30].

The six questions assigned to Factor 2 in the EFA measures behaviors related to healthcare management. The components are enjoyable daily life, stress-relief, early dementia diagnosis, conversation with family, chronic disease management, and depression reduction. Healthcare management behaviors are an important factor in preventing dementia, as shown in previous studies [11,15]. According to Wilson et al.[31], stress leads to a decrease in the ability to process and store new information, which increases the risk of developing Alzheimer’s disease. Moreover, most of the national and overseas recommendations or preventive guidelines on dementia [3-5,12] emphasize stress management, early dementia diagnosis, management of chronic diseases, and participation in social activities. Thus, stress-relief, chronic disease management, and regular cognitive function tests that enable dementia prevention or early diagnosis should be regarded as essential factors in preventing dementia.

The five questions assigned to Factor 3 in the EFA measure lifestyle. The components are regular exercise, weight control, regular sleep, regular meals, and precautions against hurting the head. The item related to regular meals was item 15, which is generally included in eating habits, but was assigned to Factor 3 in this study based on the results of the EFA. Obesity prevention, adequate sleep and regular meals are common factors related to dementia prevention, as reported in several previous studies [13,15,26]. Weight control and adequate sleep are crucial health behaviors that help prevent dementia. In addition, cognitive impairment is known to be most frequently caused by a

| Factors | Items | I | II | III | IV | V | 2 Standard error |
|---------|-------|---|----|-----|----|---|-----------------|
| I       | Item 17 | .67** |     |     |     |    | .30**           | 0.12 |
|         | Item 18 | .75** |     |     |     |    | .23**           | 0.12 |
|         | Item 19 | .69** |     |     |     |    | .20**           | 0.12 |
|         | Item 20 | .68** |     |     |     |    | .11**           | 0.11 |
|         | Item 21 | .74** |     |     |     |    | .11**           | 0.11 |
|         | Item 22 | .72** |     |     |     |    | .14**           | 0.14 |
|         | Item 23 | .57** |     |     |     |    | .16**           | 0.11 |
| II      | Item 1  | .43** | .77** |     |     |    | .26**           | 0.11 |
|         | Item 2  | .45** | .82** |     |     |    | .19**           | 0.13 |
|         | Item 3  | .30** | .63** |     |     |    | .16*            | 0.14 |
|         | Item 4  | .50** | .65** |     |     |    | .37**           | 0.12 |
|         | Item 5  | .50** | .64** |     |     |    | .35**           | 0.12 |
|         | Item 6  | .49** | .78** |     |     |    | .23**           | 0.13 |
| III     | Item 12 | .36** | .34** | .50** |     |    | .17*            | 0.13 |
|         | Item 13 | .27** | .26** | .62** |     |    | .10**           | 0.13 |
|         | Item 14 | .38** | .24** | .51** |     |    | .01             | 0.13 |
|         | Item 15 | .26** | .26** | .55** |     |    | .02             | 0.12 |
|         | Item 16 | .36** | .38** | .50** |     |    | .14*            | 0.12 |
| IV      | Item 7  | .01  | -.12 | -.02 | .71** |    | .31**           | 0.10 |
|         | Item 8  | .15* | -.00 | .08  | .71** |    | .28**           | 0.11 |
| V       | Item 9  | .31** | .38** | .27** | .19** | .40** | 0.11 |
|         | Item 10 | .02  | -.01 | .13* | .22** | .42** | 0.10 |
|         | Item 11 | .19** | .23** | -.01 | .32** | .59** | 0.10 |

*p < .05, **p < .01.
functional abnormality in the frontal lobe, such as memory loss after a mild traumatic brain injury and reduced attention [32]. This suggests that it is very important to avoid a repeated head injury in daily life, regardless of the degree of impact. Dhana et al. [30] also showed that the risk of dementia decreased in individuals with a healthy lifestyle, compared to those with an unhealthy lifestyle, emphasizing the critical role of lifestyle in preventing dementia.

The two questions assigned to Factor 4 in the EFA measure the smoking and drinking behaviors. The components were non-smoking and moderate drinking. In a seven-year cohort study by Liu et al. [33], the non-drinkers showed a .79- and .87-times lower risk of dementia for men and women, respectively, compared to individuals who drank daily. Drinking more than one drink per day would increase the risk of dementia. As a result, the smoking and drinking factor is deemed suitable for the prevention of dementia.

The three questions assigned to Factor 5 in the EFA measure eating habits. The components are regular intake of vegetables and fruits, avoiding fatty foods, and eating blue-backed fish. Omega-3 fatty acids facilitate blood supply to the brain, while vitamins E and C exhibit antioxidant activities in healthy brain vessels. The lack of vitamin B6 or B12 and folic acid is known to increase the concentration of homocysteine in the blood, which increases the risk of vascular diseases [29]. Thus, it is essential to reduce one’s intake of saturated fatty acids and ensure an adequate intake of vitamins to prevent dementia. The conventional Prevention of Dementia tool in Lee et al. [11] contains two questions related to eating habits, while the one by Kim and Yang [15] contains three questions; further, Chen and Yoshida [34] reported that the risk of dementia decreased by 0.148 points when the score of healthy eating habits increased by 1 point. In a systematic literature review conducted by Van De Rest et al. [35], healthy diet patterns were shown to be correlated with a reduced risk of cognitive impairment and dementia. Thus, a close correlation exists between eating habits and dementia.

The factor loading in the EFA represents the level of correlation between each factor and variable. As all questions in this study had a loading of ≥ .5, the significance was substantial. Furthermore, for the reliability of the tool developed in this study, Cronbach’s α was .90 across the 23 questions and ranged between .65-.89 for each factor. The Cronbach’s α of the eating habits subsfactor was low at .65, suggesting that the items need to be clarified. Considering that an α ≥ .60 adequately confirms the reliability in an exploratory study [16], the K-HBPD in measuring health behaviors that prevent dementia is considered suitable with respect to reliability. In addition, the K-HBPD can obtain consistent responses from participants, as it does not contain heterogeneous items; furthermore, the questions may be considered as a single, comprehensive scale. The reliability of the tool developed by Lee et al. [11] has a Cronbach’s α = .75; Park [14] has a Cronbach’s α = .77; Kim and Yang [15] has a Cronbach’s α = .89; and the motivation to change lifestyle and health behaviors for dementia risk reduction scale (MCLHB-DRR) by Kim et al. [7] has .61-.86 for each factor. This indicates that the reliability of the K-HBPD in this study was the highest of all the scales.

The findings of confirming convergent and discriminant validity of K-HBPD items using multi-trait multi-items matrix analysis revealed 100% convergent validity and 97.4% discriminant validity in this study. As a result, it was demonstrated that the measuring items consistently measure construct concept and that factor independence was preserved. Item 23 and 9 were, on the other hand, within the critical value of other subscales' items. In this study, items 23 and 9 correspond to the cognitive social activities subscale and the eating habits subscale, respectively, and the eating habits subscale’s reliability did not exceed .70. As a result, more research should be done in the future to re-evaluate items 23 and 9.

A strong positive correlation was found with HPLP-II total score and each factor of K-HBPD. Meanwhile, low correlations were found for the smoking and drinking factor and the sub-categories in HPLP-II. Because 78.9% of the participants in this study were older female adults with a relatively low rate of smoking or drinking, the consequent weak explanatory power of the K-HBPD is thought to have caused low correlations with the HPLP-II.

The scale has 23 items, where items 7 and 10 had reversed coding with 5 factors, scored using a 4-point Likert type scale, ranging from 1 (Strongly disagree) to 4 (Strongly agree). The total scores of 23 items varied between 23 to 92, with higher scores indicating higher degrees of dementia prevention behaviors in older adults. The cognitive social activities factor consists of 7 items, with a score ranging from 7 to 28. The healthcare management factor consists of 6 items, with a score ranging from 6 to 24. The lifestyle factor consists of 5 items, with a score ranging from 5 to 20. The smoking and drinking factor consists of 2 items, with a score ranging from 2 to 8. The eating habits factor consists of 3 items, with a score ranging from 3 to 12 (Appendix 1).

This study was conducted in the western parts of South Korea, limiting the sample representativeness. Due to COVID-19, it was not conducted with a test-retest method.
Also, confirmatory factor analysis was not performed in this study. In addition, items 23 and 9, which did not secure the items discriminant validity, should be re-verified. However, the significance of this study lies in the fact that the K-HBPD tool allows for an integrated assessment of health behaviors to prevent dementia in older adults’ daily lives. Furthermore, the tool is verified to comply with the tool development protocol. As result, a scientifically verified and reliable dementia prevention behavior measurement tool was developed. The questions included in this tool are suitable for Korean culture and can be easily understood and answered by the older adults. Therefore, its data are anticipated to prove useful, by providing measurements of actual health behaviors for the prevention of dementia, both within the research on its developing interventions and educational programs, as well as cognitive functional enhancements in older adults.

CONCLUSION

The K-HBPD developed in this study is presumed to be suitable for older adults. The response burden is low with its small number of questions, while comprising of the following independent domains: cognitive social activities, health management, lifestyle, smoking and drinking, and eating habits to measure health behaviors that prevent dementia. The K-HBPD is predicted to enable a comprehensive analysis of behaviors exhibited by older adults in their daily lives that can prevent dementia. In addition, the explanatory power of the tool was 66.8%, which confirms an adequate level of explanation.

CONFLICTS OF INTEREST

Hye Young Kim has been editor-in-chief of the Journal of Korean Academy of Fundamentals of Nursing since January 2022. She was not involved in the review process of this manuscript. Otherwise, there was no conflict of interest.

AUTHORSHIP

Study conception and design acquisition - KH, OM, KH, JS, CH, and KHY; Data collection - KH, OM, KH, JS, and CH; Data analysis & Interpretation - KH and KHY; Drafting & Revision of the manuscript - KH, OM, KH, JS, CH, and KHY.

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## Appendix 1. 노인을 위한 한국어판 치매예방 건강행위 측정도구 (K-HBDP)

| 귀하는……... | 문항 | 전혀 안 한다 | 가끔 한다 | 종종 한다 | 항상 한다 |
|-------------|------|-------------|-----------|-----------|-----------|
| 1. 즐겁게 지내려고 노력합니까? |
| 2. 스트레스가 빼으면 잘 뭐는 편입니까? |
| 3. 매년 치매조기검진을 받고 있습니까? |
| 4. 가족들과 치매예방에 대한 대화를 자주 합니다? |
| 5. 당뇨병, 고혈압, 이상지질혈증 등 만성질환을 꾸준히 관리합니까? |
| 6. 우울할 때 우울한 기분을 잘 풀어줍니까? |
| 7. 현재 담배를 피웁니까? |
| 8. 술을 한번 마시면 3잔보다 적게 마십니까? |
| 9. 체소, 과일 등을 정거 먹으려고 노력합니까? |
| 10. 고기류와 타가 식의 음식을 좋아하는 편입니까? |
| 11. 동 푸른 생선류 등을 자주 꾸며 먹습니까? |
| 12. 체중관리를 잘 하고 있습니까? |
| 13. 매일 같은 시간에 자고 일어납니까? |
| 14. 유산소 운동 (걷기, 자전거 타기, 수영 등)을 일주일에 3회 이상 이상, 매일 20분 이상 함합니까? |
| 15. 규칙적인 식사를 합니다? |
| 16. 머리를 다치지 않도록 항상 조심합니까? |
| 17. 치매를 예방하기 위해 손을 많이 사용하는 동작이나 놀이를 자주 합니까? |
| 18. 신문이나 책 등을 자주 읽습니까? |
| 19. 자기 개발을 위해 컴퓨터, 외국어, 문화예술 등을 공부합니까? |
| 20. 치매에 대한 정보를 자주 찾아봅니까? |
| 21. 기억하는 연습을 자주 합니까? |
| 22. 자원봉사, 종교활동, 복지관 프로그램 등 사회활동에 참여합니까? |
| 23. 가족이나 친구와 자주 연락하거나 만납니까? |