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The Effect of Quality of Life and Environmental Factors (WHOQOL-BREF, MQE, and HACE) on Independent Living and Cut-off Value Analysis in the Korean Elderly: Community and Nursing Home in the City

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SUMMARY

Background: The purpose of this study was to analyze the effect of quality of life and environmental factors (WHO quality of life-BREF, measurement of quality of the environment and home and community environment) on independent living in the elderly. In addition, this study aimed to find out the cut-off value and classification accuracy with the elderly who live independently and dependently.
Material and Methods: This study was conducted with elderly people (n = 262) who are over 65 years old, living in the community and nursing home in Korea. WHO quality of life-BREF (WHOQOL-BREF), measurement of quality of the environment (MQE), and home and community environment (HACE) were used as measurement tools.
The effect of variables on independent living was examined by logistic regression analysis. Receiver operating characteristic (ROC) curve was used to investigate the usefulness and cut-off value of each measurement tool.
Results: In logistic regression analysis, all domains of WHOQOL-BREF, barrier of MQE, and HACE factors influenced the independent living of the elderly (p < 0.05).
ROC analysis to identify the independent living of the elderly showed significant results in all domains of WHOQOL (p < 0.05). MQE showed significant results only in barrier, and HACE showed significant results in HACE-community mobility, HACE-transportation factor and HACE-attitudes (p < 0.05).
Conclusion: Factors such as WHOQOL-BREF, MQE, and HACE may affect the independent living of the elderly, but the overall results of ROC analysis showed high accuracy, sensitivity, and specificity in WHOQOL-BREF.

1. Introduction

As people get older, the weakening of the whole body part occurs, which is aging.[1,2] When the level of weakening due to aging falls below a certain level and the risk of injury such as falls increases during daily activities, care and dependence increase.[3–5] When these dependencies become so severe that they cannot live independently, they have an increased need for care.[6]

In fact, elderly people often have a weakened overall condition rather than a specific illness, so it may be ambiguous to judge the independent living with only physical functions. This is because mental factors such as cognitive function, psychological factors, and environmental factors can affect the elderly who already have weak physical functions.[7–10] If these psychological and environmental aspects have an effect, the physical function is similar, but some elderly people live independently and some elderly people depend on the facilities. Therefore, in order to judge the independent living of the elderly, psychological factors and environmental factors should be considered in addition to the physical conditions.

The WHOQOL-BREF, MQE, and HACE are representative tools that assess the psychological and environmental factors of the elderly.

WHOQOL-BREF was developed by the World Health Organization (WHO) and can be used to assess older people's perceptions of quality of life. It is composed of physical health, psychological, social relationships, and environment, so that various aspects can be assessed. It has already been widely used around the world and is a proven tool of reliability.[11]

The measurement of quality of the environment (MQE) and the home and community environment (HACE) are the tools for evaluating environmental factors and can examine the barrier environment or the facilitator environment.[12,13]

All of these tools are proven instruments of reliability and are widely used for psycho-environmental assessment. However, there are not enough studies analyzing the effects of psychological and environmental factors evaluated using these tools on the independent life of the elderly. Therefore, this study analyzed the effect of quality of life and environmental factors on the independence living of the elderly. In addition, cut-off values between the elderly who live independently and the elderly who live dependently were obtained for each evaluation tool.

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2. Methods

2.1. Subjects

This study was conducted with elderly people over 65 years old living in the community and nursing homes in Gyeongsangbuk-do, Korea. Sample size for ROC analyses were calculated using easyROC: a web-tool for ROC curve analysis 1.3.1 version software.[14] We estimated an AUC of 0.6, a power of 80%, and an alpha probability of 0.05 using the single test. As the estimated sample size was 194, we recruited more than 194, to allow for dropout.

For the sampling of the subjects, the summary of the study was explained to the institutions of nursing facilities in cities located in Gyeongsangbuk-do, and the subjects were recruited from the institution that received permission to proceed with the study. Research directors and researchers visited 12 nursing homes and 20 senior centers located in D and K cities in Gyeongsangbuk-do and advertised their recruitment offline. Among the subjects who announced their intention to participate, subjects were randomly selected, and only about 10 subjects were selected from one place.

This research selected 321 people who met the selection criteria of the subjects, but 39 people rejected the consent (Figure 1).

Twenty people were dropped out in the middle of the measurement, and 262 subjects (male: 71, female: 191) were enrolled in the study. We classified the elderly into 2 groups, lifestyle (Community-dwelling/nursing homes) according to the independence of ADL (Table 1).

The selection criteria of the subjects are as follows. 1) Those who are 65 years of age or older. 2) Those who do not have serious damage to the visual sense or somatosensory that can affect the experiment. 3) Those who can walk more than 10 m by themselves. 4) Those with a level of consciousness to perform this study.

In accordance with the Helsinki Declaration of Ethics, all subjects prior to the experiment were briefed on the purpose and procedure of the study and voluntarily agreed to take part in the experiment. The study was approved by the Institutional Review Board of Daegu University.

2.2. WHO quality of life-BREF (WHOQOL-BREF)

It is a questionnaire composed of 4 domains of quality of life. The key parts of the WHOQOL-100 are selected and made into a short form. WHOQOL-BREF consists of a total of 26 questions, and is known to be as reliable and valid as WHOQOL-100.[11,15]
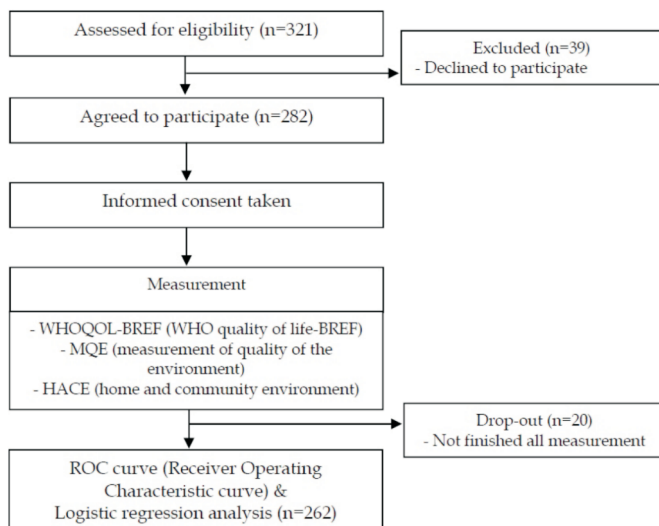
The score of each item was evaluated on a 5-point scale, and scores were obtained by adding all the scores of the items for each area. The score obtained in this way is called the raw score.

In this study, the raw score obtained in this way was not used as it was, but a method of converting to 0–100 score was used as described in the WHOQOL manual (12–15p).[16]

In the physical health domain, the intra-rater reliability was 0.94 (p < .001) and the interrater reliability was r = 0.89 (p < .001). In the psychological domain, the intra-rater reliability was r = .94 (p < .001) and inter-rater reliability was r = .95 (p < .001). In the social relationships domain, the intra-rater reliability was r = .77 (p < .001) and inter-rater reliability was r = .81 (p < .001). In the environment domain, the reliability of the interrogator was r = .92 (p < .001) and inter-rater reliability was r = .93 (p < .001). This tool has high reliability and validity.[15]

2.3. Measurement of quality of the environment (MQE)

The MQE is a scale aimed at assessing the effect of environmental impact on a person's daily life. MQE has a version with 109 questions and a short version with 26 questions. Because the subject of this study was the elderly, too many questions were judged to reduce the reliability and the short version was used. When evaluating environmental factors, it is classified as 'facilitator' to help or assist a person in performing daily life, and 'obstacle' to inhibit it. The MQE is rated on a 7-point scale.[17]

2.4. Home and community environment (HACE)

HACE measures the environment that is restricted or promoted to the subject in the home and community. It is classified into six areas as follows: home mobility, community mobility, basic mobility devices, communication devices, transportation factors, and attitudes. We measured the other four areas except for those that did not meet the conditions of the subjects of this study, such as the use of ancillary equipment such as wheelchairs (basic mobility devices) and the use of hearing aids (communication devices).[13]

2.5. Study protocol

Before conducting the experiment, the researchers received sufficient training so that they could understand the tools (WHOQOL-BREF, MQE, HACE), and a simulation was also practiced. There are 4 interviewers who conducted the survey, all of whom have more than

Figure 1. Study flowchart.

Table 1
General subject characteristics (n = 262).

Variable	Community-dwelling	Nursing homes
Age (year)	77.41 ± 7.06	80.18 ± 8.26
Height (cm)	157.12 ± 8.01	153.17 ± 7.82
Weight (kg)	56.43 ± 8.32	55.71 ± 14.97
Sex (male/female)	95/50	96/21
QOL-physical health	53.76 ± 21.19	46.71 ± 20.58
QOL-psychological	62.41 ± 21.85	51.64 ± 22.60
QOL-social relationships	58.16 ± 22.22	44.74 ± 25.56
QOL-environment	60.81 ± 19.69	60.45 ± 18.84
MQE-barrier	21.81 ± 5.99	17.32 ± 5.14
MQE-facillitator	3.74 ± 8.20	5.97 ± 5.67
HACE-home mobility	2.38 ± 1.74	1.94 ± 0.97
HACE-comunity mobility	0.28 ± 0.61	0.50 ± 0.87
HACE-transportation factor	1.54 ± 1.22	1.91 ± 0.47
HACE-attitudes	1.31 ± 1.05	0.68 ± 0.86

Mean ± SD, standard deviation.

3 years of clinical experience.

Because the subject has the characteristic of being an elderly person, the interviewers conducted the experiment by verbally asking questions and filling up the questionnaire so that the subjects could understand the contents of the question. After asking the subject, the researchers waited long enough without asking for an answer and proceeded to the next question.

To exclude bias for learning effects, the order of measuring tools was randomly assigned to each subject (WHOQOL-BREF, MQE, HACE). Because the subjects may not be able to concentrate for long periods of time, each of the tools was not evaluated at once but was measured on a different day. After one questionnaire was completed, the subjects were asked to schedule a meeting for the next evaluation. The measurement results are expressed as mean ± standard deviation.

2.6. Statistical analysis

SPSS for Windows (version 23.0) was used to analyze the data of this study. Descriptive statistics were used to determine the general characteristics of the subjects.

In order to investigate the effect of each variable on the independent living, we classified the group into independent living group and dependent living group according to the lifestyle of the subjects and then examined the influence by logistic regression analysis.

Receiver operating characteristic (ROC) curve was used to determine the usefulness and cut-off value of each measurement method. The cut-off point was found using the Youden Index (Youden's J statistic), '(sensitivity) + (specificity-1) = maximum sum'.[18] Statistical significance was set at .05.

3. Results

3.1. The impact of QOL and environmental factors on independent living

Significant results were found in all areas of WHOQOL regarding the loss of independent living of the elderly; physical health domain (OR = 0.823), psychological domain (OR = 0.762), social relationships domain (OR = 0.692), and environment domain (OR = 0.798) (p < 0.05). MQE was significant only in the barrier (OR = 0.871) (p < 0.05). HACE showed significant results in all domains; home mobility (OR = 0.806), community mobility (OR = 0.571), transportation factor (OR = 1.497) and attitudes (OR = 0.491) (p < 0.05) (Table 2).

3.2. The cut-off value that distinguishes the independent living movement of the elderly

ROC analysis to identify the independent living of the elderly showed significant results in all domains of WHOQOL; physical health domain (cut-off = 30.129; sensitivity = 89.7%; specificity = 97.4%; AUC = 0.932), psychological domain (cut-off = 29.372, sensitivity = 93.8%, specificity = 100%, AUC = 0.975), the social relationships domain (cut-off = 17.000; sensitivity = 97.9%; specificity = 100%; AUC = 0.983), the environment domain (cut-off = 37.500; sensitivity = 90.3%; specificity = 96.6%; AUC = 0.955) (p < 0.05).

MQE showed significant results only in barrier (cut-off = 20.765; sensitivity = 68.3%; specificity = 75.2%; AUC = 0.797). HACE showed significant results in HACE-community mobility (cut-off = 1.882; sensitivity = 34.5%; specificity = 99.1%; AUC = 0.588), HACE-transportation factor (cut-off = 2.757; sensitivity = 20.7%; specificity = 94.0%; AUC = 0.360), HACE-attitudes (cut-off = 0.992; sensitivity = 76.6%; specificity = 65.8%; AUC = 0.671) (p < 0.05) (Table 3) (Figure 2).

4. Discussion

In this study, participants were all recruited from communities and nursing homes. The reason for recruiting subjects from 2 places is that frail elderly have similar physical levels, but their lifestyles are divided into those who live independently and those who live in nursing homes.

It was assumed that in addition to the physical factors, the quality of life and environmental factors also influenced the lifestyle, and to find out, subjects were recruited from two groups.

WHOQOL-BREF, MQE, and HACE were used to measure the quality of life and environmental factors of the elderly. The elderly were classified into the elderly living independently and the elderly living dependently in nursing home after performing these measurement tools. After that, we analyzed the effect of the domains of each tool on the independent living and examined the cut-off value and accuracy through ROC analysis.

In this study, the total points of each domain of WHOQOL were converted into 100 points.

Table 2
The effect of the independent living on the elderly by factors.

Variable	B	S.E	Wald	p	OR
QOL-physical health	-0.195	0.027	51.514	0.000*	0.823
QOL-psychological	-0.272	0.047	33.921	0.000*	0.762
QOL-social relationships	-0.368	0.072	26.324	0.000*	0.692
QOL-environment	-0.226	0.032	50.311	0.000*	0.798
MQE-barrier	-0.138	0.024	31.991	0.000*	0.871
MQE-facillitator	-0.015	0.018	0.749	0.387	0.985
HACE-home mobility	-0.216	0.091	5.592	0.018*	0.806
HACE-comunity mobility	-0.561	0.153	13.518	0.000*	0.571
HACE-transportation factor	0.404	0.136	8.856	0.003*	1.497
HACE-attitudes	-0.710	0.149	22.864	0.000*	0.491

* p < .05.

Table 3
Cut-off analysis between independent living and dependent living in the elderly by factors.

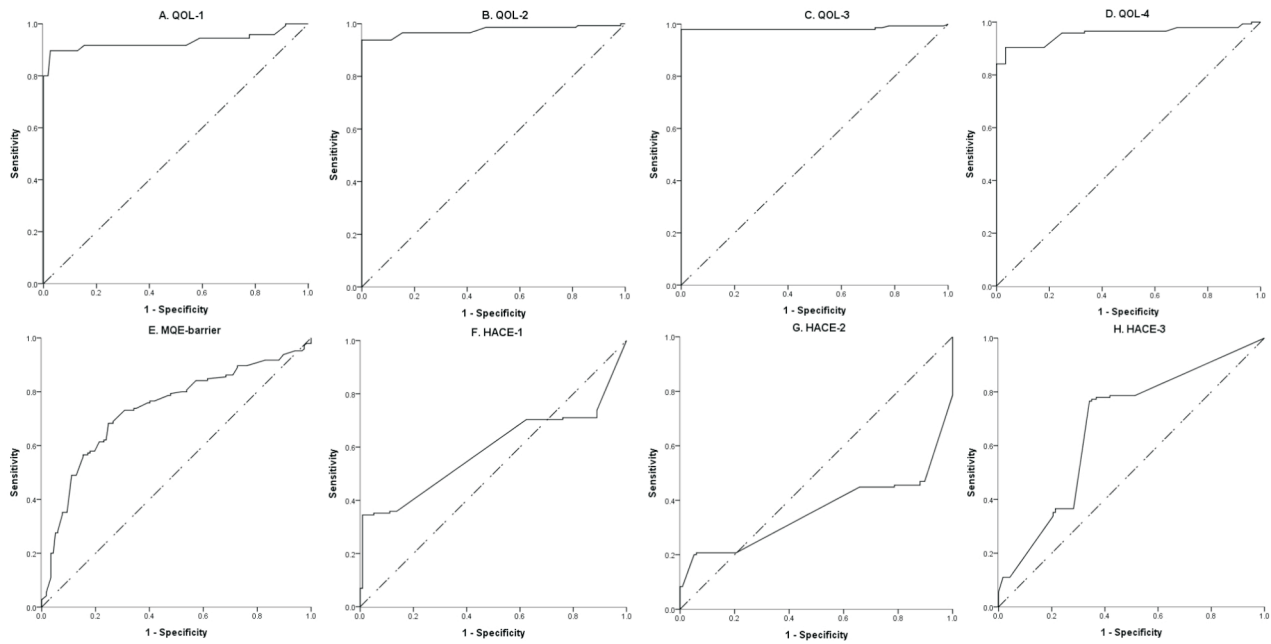| Variable	Cut-off	Sensitivity	Specificity	p	ROC-AUC (95% CI)
QOL-physical health	30.129	0.897	0.974	0.000*	0.932 (0.869–0.967)
QOL-psychological	29.372	0.938	1.000	0.000*	0.975 (0.955–0.995)
QOL-social relationships	17.000	0.979	1.000	0.000*	0.983 (0.963–0.999)
QOL-environment	37.500	0.903	0.966	0.000*	0.955 (0.928–0.982)
MQE-barrier	20.765	0.683	0.752	0.000*	0.797 (0.675–0.798)
MQE-facillitator	9.679	0.310	0.803	0.747	0.488 (0.418–0.559)
HACE-home mobility	0.945	0.959	0.171	0.654	0.516 (0.444–0.588)
HACE-community mobility	1.882	0.345	0.991	0.014*	0.588 (0.518–0.658)
HACE-transportation factor	2.757	0.207	0.940	0.000*	0.360 (0.291–0.428)
HACE-attitudes	0.992	0.766	0.658	0.000*	0.671 (0.604–0.738)

* p < .05.

Figure 2. Receiver operating characteristic (ROC) curves for independent living. QOL, WHO quality of life; MQE, measurement of quality of the environment; HACE, home and community environment; QOL-1, QOL-physical health; QOL-2, QOL-psychological; QOL-3, QOL-social relationships; QOL-4, QOL-environment; HACE-1, HACE-community mobility; HACE-2, HACE-transportation factor; HACE-3, HACE-attitudes.

The results of this study showed that the higher the score in each domain of WHOQOL, the higher the probability of independent living. The odds ratio and cut-off value for each domain are as follows: in the WHOQOL physical health domain, the odds ratio was 0.823, the cut-off value was 30.129, the sensitivity was 0.897, and the specificity was 0.974.

Area under the curve (AUC) was 0.932, greater than 0.5, and significant, and the accuracy was excellent. This means that the probability of living in a group decreases 0.829 times as the physical health domain score increases by one point, based on 30.129 points.

In the psychological domain of WHOQOL, the odds ratio was 0.762, the cut-off value was 29.372, the sensitivity was 0.938, and the specificity was 1.000. AUC was 0.975, greater than 0.5, and significant, and the accuracy was excellent. This result can be interpreted that the probability of living in a group decreases 0.762 times as the psychological domain score increases by one point, based on 29.372 points.

In the social relationships domain of WHOQOL, the odds ratio was 0.692, the cut-off value was 17.000, the sensitivity was 0.979, and the specificity was 1.000.

AUC was 0.983, greater than 0.5, and significant, and the accuracy was excellent.

This result can be interpreted that the probability of living in the group decreases by 0.692 times as the social relationship domain score increases by 1 point, based on 17.000 points.

In the WHOQOL environment domain, the odds ratio was 0.798, the cut-off value was 37.500, the sensitivity was 0.903, and the specificity was 0.966. AUC was 0.955, greater than 0.5, and significant, and the accuracy was excellent. This result can be interpreted that the probability of living in a group decreases by 0.798 times as the environmental score increases by one point, based on 37.500 points.

In previous studies on WHOQOL and everyday life, Levosseur et al.[19] measured the QOL by dividing the elderly into good activity level group, moderate to severe activity limitations group, and moderate to severe activity limitations group according to daily living levels. In QOL physical health domain, healthier elderly group had the higher score. In the QOL psychological domain, with good activ-

ity level group was higher than the severe activity limitations group. This finding is consistent with the results of this study suggesting that the higher the score of QOL, the more likely it is to live independently.

Ozcan et al.[20] found that the strength, balance ability, and proprioception of the elderly were positively correlated with the physical health domain of the QOL. The study by Hausdorff et al.,[21] reported that there was a positive correlation between gait ability, which is an essential ability for independent living, and the four domains of QOL. In addition, the higher the QOL, the lower the risk of daily life limitations and falls.

The scores of physical and environmental domains were also lower in the elderly with ADL limitation.[22] This result is in agreement with the results of this study, and the fact that the elderly with limited ADL have low QOL supports the results of this study.

In a study by Bodur & Cingil,[23] elderly people living in assisted living facilities showed lower scores of social relationships and environment domains of WHOQOL than elderly people living independently. This result is consistent with the results of this study.

The effect of WHOQOL on the lifestyle of the elderly was also significant in each area, and the accuracy of the cut-off value was high. Elderly people with high QOL scores were more likely to live independently.

In this study, the greater the barrier environment of MQE in the elderly, the higher the probability of independent living. The odds ratio was 0.871, the cut-off value of ROC curve was 20.765, the sensitivity was 68.3%, and the specificity was 75.2%. AUC was 0.797, greater than 0.5, and significant, and the accuracy was fair. This result can be interpreted that the probability of living in the group decreases 0.871 times as the barriers score increases by 1 point based on 20.765 points. However, the relationship between the facilitator environment of the MQE and the life style of the elderly was not significant.

Fougeyrollas et al.[12] reported that the MQE scale can be used to assess the environmental impact of an individual's activity of daily life (ADL) and to assess scores in a facilitator environment and barrier environment.

Levasseur et al.[19] measured the MQE by dividing the elderly into good activity level groups, moderate to moderate activity limitations groups, and moderate to severe activity limitations groups according to daily living levels. There were no significant differences between the groups in facilitators and obstacles. There was no significant difference in facilitators, consistent with the results of this study. However, unlike Levasseur et al.'s study, this study showed significant results in obstacles (barrier environment). These results indicate that the higher the obstacle, the more likely it is to live independently. This seems to be the result of the fact that the elderly living independently are able to live without being restricted to obstacles.

Although the facilitator environment of the MQE was not significant, the barrier environment could affect the lifestyle of the elderly and the accuracy of classifying the lifestyle was fair.

This study examined the effect of each domain of HACE on the life style of the elderly, the odds ratio of home mobility to life style was 0.806 and the ROC curve analysis was not significant. This result shows that the probability of living in a group decreases by 0.806 as the score of home mobility increases by one point, but it can be interpreted that it is difficult to classify the lifestyle.

In the community mobility of HACE, the odds ratio was 0.571, the cutoff value of ROC curve was 1.882, the sensitivity was 34.5%, and the specificity was 99.1%. The area of the lower part of the ROC curve was 0.588, which was greater than 0.5 and significant but the accuracy was fail. This result can be interpreted that the probability of living in a group decreases by 0.571 times as the number of community mobility increases by one point based on 1,882 points.

The odds ratio was 1.497 for the transportation factor of HACE. The cut-off value of ROC curve was 2.757, sensitivity was 20.7%, and specificity was 94.0%. The area of the lower part of the ROC curve was 0.360, less than 0.5, so the p value was significant, but the accuracy was worthless. This result can be interpreted that the probability of living in a group increases by 1.494 times as the transportation factor score increases by one point, but it seems pointless to estimate the cut-off value.

In the attitudes of HACE, the odds ratio was 0.491, the cut-off value of ROC curve was 0.992, the sensitivity was 76.6%, and the specificity was 65.8%. The area of the lower part of the ROC curve was 0.671, greater than 0.5 and significant, and the accuracy was poor. This result can be interpreted that the probability of living in a group decreases by 0.491 times as the attitudes score increases by one point based on 0.992 points, but it seems pointless to estimate the cut-off value because of the poor accuracy of AUC.

The elderly were more likely to live independently as the score of HACE's home mobility, community mobility, and attitudes increased. In contrast, as the HACE's transportation factor score increases, the probability of living in a group dependently increases.

In the home mobility of HACE, Keysor et al.,[13] who concluded that the independent living elderly had a higher number of obstacles than the elderly living in a group, were consistent with the results of this study. In the remaining domains, there were slight differences from the results of this study because of the different subject groups. Keysor et al.[13] included people over 21 years of age but this study included elderly people aged 65 years or older. The number of subjects was also higher in this study.

WHOQOL, MQE, and HACE have similarities in that they can assess social relationships and environmental factors. However, HACE was less accurate or meaningful than the other two tools in distinguishing lifestyle among the elderly through ROC analysis.

In conclusion, factors such as WHOQOL-BREF, MQE, and HACE may affect the independent living of the elderly, but the overall results of ROC analysis showed high accuracy, sensitivity, and specificity in WHOQOL-BREF.

The limitation of this study is that this study does not cover the elderly for specific diseases, so there may be some bias. However, in the case of elderly people, most of them have chronic diseases even if they are not specific diseases. In this study, the study was conducted on these elderly people, and there was no significant difference in the physical level.

In order to minimize sample bias in the study and to ensure that the sample is representative, only a small number of subjects were randomly selected for each institution. However, it is impossible to completely rule out some prejudice. For example, in this study, research was conducted on elderly people in urban areas, but the results may be different if conducted in rural areas.

In addition, since the study was conducted with the elderly with cognitive level enough to carry out the research, detailed changes according to cognitive level could not be found. In addition, it did not include the body motor function area, did not use all statistical methods available for the study, and analyzed using only a few methods.

In this study, the effects of factors of WHOQOL-BREF, MQE, and HACE on the independent living in the elderly and the cut-off value were analyzed. As a result, WHOQOL-BREF, MQE, and HACE factors may affect the independent living of the elderly. However, even similar domains may differ in the detailed context depending on the tool being measured, which may result in different results even if the subjects are the same.

In the ROC analysis, there was a difference in accuracy. HACE had less accuracy and meaningful than the other two tools and overall, WHOQOL showed high accuracy. The results of this study can be used as a reference for the research on the life style, environment and quality of life of elderly people.

Conflict of interest

There are no conflicts of interest regarding this research.

References

1. Goodpaster BH, Park SW, Harris TB, et al. The loss of skeletal muscle strength, mass, and quality in older adults: The health, aging and body composition study. *J Gerontol A Biol Sci Med Sci*. 2006;61:1059–1064.
2. Tieland M, Trouwborst I, Clark BC. Skeletal muscle performance and ageing. *J Cachexia Sarcopenia Muscle*. 2018;9:3–19.
3. Clegg A, Young J, Iliffe S, et al. Frailty in elderly people. *Lancet*. 2013; 381:752–762.
4. Rochat S, Cumming RG, Blyth F, et al. Frailty and use of health and community services by community-dwelling older men: The concord health and ageing in men project. *Age Ageing*. 2010;39:228–233.
5. Kim SG, Hwangbo G. The effect of obstacle gait training on the plantar pressure and contact time of elderly women. *Arch Gerontol Geriatr*. 2015;60:401–404.
6. Villas Boas PJ, do Valle AP, Jacinto AF, et al. Loss of independence in activities of daily living in older adults hospitalized. *Innov Aging*. 2017;1:358.
7. Barrera G, Cases T, Bunout D, et al. Associations between socioeconomic status, aging and functionality among older women. *Geriatr Nurs*. 2017; 38:347–351.
8. Wright SL, Kay RE, Avery ET, et al. The impact of depression on dual tasking among patients with high fall risk. *J Geriatr Psychiatry Neurol*. 2011; 24:142–150.
9. Iwarsson S, Isacsson Å, Lanke J. ADL dependence in the elderly population living in the community: The influence of functional limitations and physical environmental demand. *Occup Ther Int*. 1998;5:173–193.
10. Kim MK, Kim TH, Kim SG. Correlation between the mini mental state examination-Korean version and the measurement of quality of the environment in the institutionalized elderly. *J Phys Ther Sci*. 2015;27:3583–3584.

11. World Health Organization. Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychol Med.* 1998;28: 551–558.

12. Fougeyrollas P, Noreau L, St-Michel G, et al. *Measure of the quality of the environment, version 2.0*. Quebec, Canada: INDCP; 2008.

13. Keysor J, Jette A, Haley S. Development of the home and community environment (HACE) instrument. *J Rehabil Med*. 2005;37:37–44.

14. Goksuluk D, Korkmaz S, Zararsiz G, et al. Easyroc: An interactive web-tool for ROC curve analysis using R language environment. *R J.* 2016;8:213–230.

15. Hwang HF, Liang WM, Chiu YN, et al. Suitability of the WHOQOL-BREF for community-dwelling older people in Taiwan. *Age Ageing*. 2003;32:593–600.

16. World Health Organization. *WHOQOL-BREF: Introduction, administration, scoring and generic version of the assessment: Field trial version, December 1996*. Geneva, Switzerland: World Health Organization; 1996.

17. Rochette A, Desrosiers J, Noreau L. Association between personal and environmental factors and the occurrence of handicap situations follow-ing a stroke. *Disabil Rehabil.* 2001;23:559–569.

18. Youden WJ. Index for rating diagnostic tests. *Cancer.* 1950;3:32–35.

19. Levasseur M, Desrosiers J, St-Cyr Tribble D. Do quality of life, participation and environment of older adults differ according to level of activity? *Health Qual Life Outcomes.* 2008;6:30.

20. Ozcan A, Donat H, Gelecek N, et al. The relationship between risk factors for falling and the quality of life in older adults. *BMC Public Health.* 2005;5:90.

21. Hausdorff JM, Rios DA, Edelberg HK. Gait variability and fall risk in community-living older adults: A 1-year prospective study. *Arch Phys Med Rehabil*. 2001;82:1050–1056.

22. Kumar SG, Majumdar A, G P. Quality of life (QOL) and its associated factors using WHOQOL-BREF among elderly in urban puducherry, India. *J Clin Diagn Res.* 2014;8:54–57.

23. Bodur S, Dayanir CD. Using WHOQOL-BREF to evaluate quality of life among Turkish elders in different residential environments. *J Nutr Health Aging.* 2009;13:652–656.