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Development and Validation of Life Safety Awareness Scale of High School Students and Analysis of Interindividual Differences

Soon-Beom, Lee*, Eun-Mi, Kim**, Ha-Sung, Kong***

**Doctor, Gunsan Jeil High School, 142 Gyeonggijang-ro, Gunsan-si, Jeollabuk-do, Korea*
***Researcher, Education Assignment Institute, Jeonbuk National University, Jeollabuk-do, Korea.*
****(Corresponding Author) 55338 Associate professor, Dept. of Fire Protection and Disaster Prevention, Woosuk Univ, 443 Samnye-ro, Samnye-eup, Wanju-gun, Jeollabuk-do, Korea*
E-mail: { sbl610, lyly524, 119wsu@naver.com}

Abstract

Life safety awareness level diagnosis is necessary for customized safety education and continuous safety awareness. As the starting stage of safety education for each life cycle, a scale that has verified the reliability and validity of high school students' life safety awareness has not yet been developed. In this context, the purpose of this study is to develop and validate the life safety awareness scale of high school students and to analyze interindividual differences. Questionnaire data was collected from April to June 2022 from 834 students in the first, second, and third grades of high schools in △△ city in Jeollabuk-do. A final 25-item scale was developed using the preliminary survey, preliminary test, the main test, descriptive statistical analysis, and exploratory and confirmatory factor analysis. This scale consists of four sub-factors: 'safety prevention', 'safety knowledge', 'safety preparation', and 'safety protection'. Good reliability and validity were verified by analysis of content validity and construct validity. The generalizability of the scale was verified by crossover validation between the search group and the crossover group. Based on the interindividual differences analysis, although there was a difference between genders in life safety awareness, there was no difference by grade level and academic achievement. This study is significant in developing the first valid scale that can measure high school students' life safety awareness and providing the necessity and rationale for life safety education by life cycle considering individual gender differences.

Keywords: *Scale Development, Crossover Validation, Interindividual Differences Analysis, Life Safety Awareness, High School Students*

1. INTRODUCTION

In the 21st century, as the unsafe factors that threaten human life and property, such as the COVID-19 epidemic, become complex, diversified and internationalized, interest in living safety at the national level is increasing. The Ministry of Public Safety and Security (2016) analyzes the current status of safety education

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Corresponding Author: 119wsu@naver.com(Ha-Sung, Kong)
Tel: +82-63-290-1686, Fax: +82-63-290-1478
Associate Professor, Dept. of Fire and Disaster Prevention, Woosuk Univ., Korea

at home and abroad and emphasizes the importance of safety education by life cycle by categorizing education fields and systematizing education contents by life cycle [1]. Safety competencies to be needed according to the life cycle from infancy to old age are presented for each type of disaster and safety accident. Schools are also putting more importance on the operation of safety education in connection with elementary, middle, and high school levels in the 2015 revised curriculum [2]. The repeated learning of safety awareness is being reinforced from an early age so that safe behaviors are cut into the body and practiced unconsciously. Unconscious safety behavior formed through repeated and continuous safety education from childhood to adolescence can be the ultimate goal and means to ensure a safe life.

Just as safety awareness measurement must be prioritized for safety education to prevent accidents, the first step should be to determine the level of safety awareness by cycle for systematic life cycle customized safety training. However, the development of a scale whose reliability and validity has been verified to measure such a level of safety is still insufficient. The ministry of Public Safety and Security (2016) [1] and the Ministry of Education (2015) set the direction of safety education by life cycle by categorizing safety education fields by life cycle and systematizing the contents of education [2]. However, as the starting stage of safety education for each cycle, a scale that has verified reliability and validity to measure safety awareness has not yet been presented. Self-measurement of one's own level of safety awareness can predict safety accidents and help prevent accidents in advance. Also, it helps to correct one's lack of safety habits and can be utilized as a customized educational material for safety education [3]. From this point of view, for systematic and effective life safety education, there is a need to precede research on the development of scales that have proven reliability and validity to measure life safety awareness.

Looking at the previous studies on the development of the safety awareness scale so far, a scale of safety awareness was developed that was classified or integrated into fire safety, disaster safety, and living safety for middle school students and the general public. Kim Hye-won and Lee Myung-sun (2002) divided the safety awareness fields into school safety, home safety, traffic safety, first aid, and fire safety for middle school students and developed the scale to prevent and cope with large and small safety accidents in their daily life [4]. This is significant as the first study to measure life safety awareness among middle school students. The Fire Department (2007) divided the scope of safety into living safety, fire safety, and disaster safety for adults over the age of 20 and developed a national safety awareness index for each [5]. However, the safety culture of the school related to education was not reflected, and the study target is the general public, so there is a limit to applying it to actual school sites. In addition, one of the common problems of previous studies, the lack of construct validity testing for measurement tools can be pointed out. Therefore, a scale that can measure high school students' life safety consciousness, whose reliability and validity have been verified, has not yet been developed.

Lee Soon Beom and Kong Ha-sung (2021) developed the first scale that verified the reliability and validity of high school students' fire safety and disaster safety awareness according to the classification of safety ranges of the National Fire Service (2007) [6]. It is meaningful as prior research on the development of tools for measuring high school students' safety awareness and customized educational materials for safety education. However, to measure high school students' life safety awareness by linking safety accident risk awareness, understanding of causes and consequences of accidents, accident prevention and situation management, and the ability to practice rescuing others in everyday life such as school and home, it is necessary to develop additional scales whose validity have been verified.

Interindividual differences among students, such as gender, academic achievement, grade level, and school location, can directly or indirectly affect the perception of safety in life. In the analysis of public safety awareness among adults by the National Fire Service (2007) and the development of tools to measure safety awareness in middle school students by Hye-won Kim and Myung-sun Lee (2002) [4-5], it was found that there were differences in the level of fire safety awareness by region. In addition, in the fire safety awareness profile analysis of high school students by Lee Soon Beom and Kong Ha-Sung (2021) [7], it was found that there was a difference in the fire safety awareness between genders. Therefore, it is necessary to find out whether there is a difference according to the individual differences in life safety awareness through individual difference analysis.

In sympathy with the necessity and awareness of the need for such research, the purpose of this study was

set to develop and validate a scale of living safety awareness and analyze individual differences for high school students. This has significance as the first scale to measure high school students' safety awareness, and it can be used as a customized safety education material for each life cycle. Specific research questions are as follows.

First, how can the high school life safety awareness scale be structured?

Second, how about the reliability and validity of the high school life safety awareness scale?

Third, are there differences by gender, academic achievement, and grade in high school life safety awareness scale factors?

2. THEORETICAL BACKGROUND

In relation to the main purpose of this study, the development of the safety awareness scale, the previous studies on the concept of safety awareness and the development of the scale were reviewed as a theoretical background.

2.1. Life Safety Awareness

The term “safety” is used in various meanings and it is difficult to abbreviate it in one word, but in terms of safety engineering, it is stable and non-hazardous, so it means a state in which there is no risk of damage or damage. Consciousness in the dictionary meaning is the totality of mental phenomena that are directly experienced in reality. Therefore, consciousness is often used in the same sense as psychology, experience, phenomenon, etc., and is often identified with 'waking state' [8]. Considering the meaning of safety and consciousness, life safety consciousness can be defined as the cognitive ability for safety to prevent accidents without feeling danger [9].

2.2. Development of Safety Awareness Scale

Table 1 summarizes the characteristics of major prior studies related to the development of a safety awareness scale [7]. As a scale to measure the safety awareness of high school students has not yet been developed, this study mainly focused on the preceding studies related to the development of the safety awareness scale. A review on the development of a general safety awareness scale can help to understand and apply the process of item search, exploratory and confirmatory factor analysis procedures.

S. J. Hong and S. H. Kim (2017) developed a scale of safety awareness on water by using the Rasch rating scale model for elementary school students [10]. The Fire Service (2007) developed a life safety awareness index as a part of the behavior change model and safety awareness index development for general adults [5]. S. B. Lee and H. S. Kong (2021) developed a fire safety awareness scale with proven reliability and validity for high school students and analyzed the differences in safety awareness by gender, grade and achievement [7]. S. B. Lee and H. S. Kong (2021) developed a validated disaster safety awareness scale for high school students and analyzed the difference in profile safety awareness [6]. Dikmenli, Yakar & Konca (2018) developed a disaster risk awareness diagnostic test scale for preservice teachers and provided educational materials for pre- and post-disaster countermeasures [11]. Jennifer A et al. (2019) developed a safety climate diagnostic scale for fire fighters and used it as a safety awareness psychological measurement tool for fire fighters [12].

Table 1. Prior research related to safety awareness measurement

Author	Title	Number of items and factors	Test Subject	Remarks
S. J. Hong, S. H. Kim (2017)	Development and validation of water safety awareness scale for elementary school students using Rasch rating scale model	30 items, 4 factors	elementary school students	Safety Awareness Scale Development
National Fire Agency (2007)	National Fire Agency, Behavior Change Model and Safety Awareness Index Development Study,	18 items	Normal Adult	Development of Life Safety Awareness Index
S. B, Lee, H.S. Kong (2021)	Scale Development and Profile Analysis of High School Students' Fire Safety Awareness: Evidence from South Korea	22 items, 4 factors	High School Students	Development of Fire Safety Awareness Scale
S. B, Lee, H.S. Kong (2021)	Development and Validation of an Instrument to Measure High School Students' Disaster Safety Awareness	24 items, 4 factors	High School Students	Development of Disaster Safety Awareness Scale
Dikmenli, Yakar & Konca (2018)	Development of Disaster Awareness Scale: A Validity and Reliability Study	36 items, 4 factors	Preservice Teacher	Development of Disaster Safety Awareness Scale
Jennifer A et at (2019)	Development and Validation of the Fire Service Safety Climate Scale.	38 items, 8 factors	Fire fighting public official	Development of Fire Station Safety Climate Diagnosis Scale

3. METHODS

3.1 Research Model

The purpose of this study is to develop and validate the safety awareness scale of high school students whose reliability and validity have been verified and based on this, analyze what differences there are in life safety awareness by gender, academic achievement, and grade level. The structure of the research model for this is shown in Figure 1.

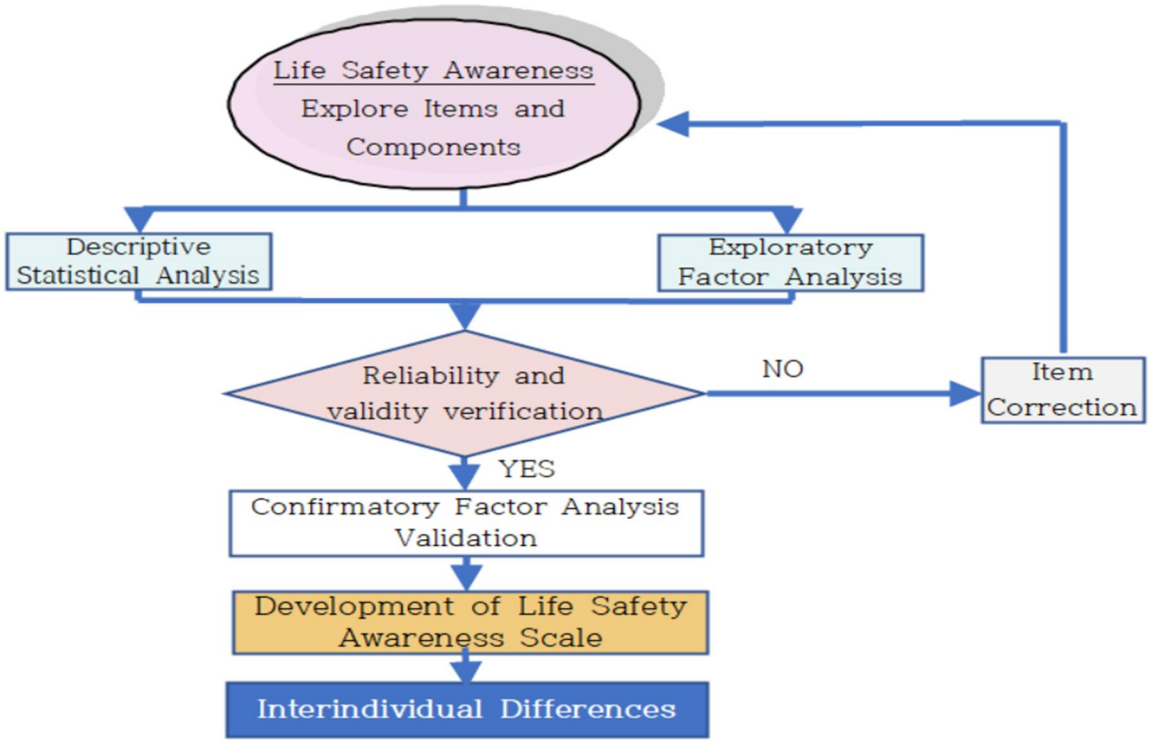

Figure 1. Research model

For this scale development process, Netemeyer, Bearden & Sharma's (2003) 'Scale Development Procedure' , DeVellis' (2003) 'Scale Development-Theory and Application', and Soon Beom Lee and Ha-sung Kong's previous studies on safety awareness scale development [6] were referenced [6] [13-14].

3.2. Research Subject

A survey was conducted from April 25 to June 10, 2022, targeting 834 high school students in grade 1.2.3(male: 466, female: 368) in △△ city, Jeollabuk-do. In order to verify the cross-validation of the scale, the study subjects were composed of a search group and a crossover group. Table 2 shows the distribution of subjects in the preliminary survey, preliminary test, main test, exploratory group, and crossover group.

Table 2. Distribution of gender, search group and crossover group

	Division	Preliminary Survey	Preliminary Test	Main Test	Total
Sex	Male	110	102	254	466
	Female		116	252	368
	Sum	110	218	506	834
Group	Search Group			253	506
	Crossover Group			253	

3.3. Procedure and Scope of the Study

According to the research model shown in <Figure 1>, preliminary questions were developed based on previous studies related to students' safety awareness and safety education-related data. In consideration of this, the experts with more than 10 years of experience in this field, doctoral level, and professors were appointed as item review committee members. High school students (23 people) and experts (8 people) were asked to revise and supplement the searched questions and to describe the questions to be added. Considering the analysis of differences in life safety awareness considering individual differences by grade, 10 high school first graders, 10 second graders, and 10 third graders were asked to evaluate for the suitability of the questions. Alternative questions were created for sentences that did not reflect the concept of safety awareness well and were awkward or difficult to understand at the high school level. The range of item content of the safety awareness scale was limited to the high school life safety education field suggested by the Ministry of Education (2015) [2].

3.4. Measurement Tools and Data Analysis

The score of each question was calculated using the Likert-type 4-step rating scale. 1 point for ‘not at all’, 2 points for ‘disagree’, 3 points for ‘agree’, and 4 points for ‘strongly agree’. SPSS 26.00, Amos 27 and Mplus 8.4 were used to analyze the reliability and validity of the scale.

Data analysis of the safety awareness scale was conducted in the order of item and descriptive statistical analysis, exploratory factor analysis, and confirmatory factor analysis. Looking at the fit criteria of the model, a CFI (Comparative Fit Index) value of .9 or higher is considered a good fit [15]. If the absolute fit index RMSEA (Root Mean Square Error of Approximation) is between .05-.08, it is considered a good fit [16]. SRMR (Standardized Root Mean Square Residual) is a standardized exponent, and when it is less than .08, it can be considered to have a good fit [17]. To confirm the possibility of generalization by cross-validation, confirmatory factor analysis was performed by dividing the study subjects into a search group and a crossover group. When the reliability and validity of the search group and the crossover group are high and the difference is insignificant, the possibility of generalization can be increased [18]. In the analysis of inter-individual differences, based on the Greenhouse-Geiseer value of the Mauchly sphericity test for intra-individual effect testing, if the result is significantly $p < .001$, it is considered that there is an inter-individual difference [14].

4. RESULTS

4.1. Preliminary Survey

A total of 103 copies were used for analysis, excluding 7 copies that responded insincerely. The Alpha factor extraction method was applied to factor extraction to determine the number of statistically significant factors for 50 items.

In the preliminary survey, 5 items corresponding to this were removed from the preliminary examination questions, and the expression of some questions was corrected. Finally, a preliminary examination questionnaire consisting of 46 questions was developed by adding one new question.

4.2. Preliminary Test

A total of 214 copies were used for the analysis, excluding 5 copies that answered insincerely. This survey questionnaire consisting of a total of 35 items was developed by removing 11 items showing high load in two or more factors or high factor loading in other factors.

4.3. Main Test

Among the 35 questions of the preliminary test, questions 1, 9, 11, 13, 18, 19, 21, 25, 32, and 33 that show high factor loading in two or more factors or high factor loading in other factors are removed to form 4 factors with at least 3 questions. The loads of all factors ranged from .39 to .87, which was found to satisfy the appropriate load criteria of .30 or more. Factor extraction was performed by applying Pro-Max of Alpha Factoring and Oblique Factor Rotation. When the KMO (Kaiser-Mayer-Olkin Measure) value is .6 or more, it is generally regarded as data that can be applied to factor analysis [19]. The fit of factor analysis was found to be good in the results of KMO and Bartlett's sphericity test presented in Table 3.

Table 3. Factor analysis KMO and bartlett's test

Kaiser-Mayer-Olkin Measure		.889
Bartlett's Sphericity Test	Approximate chi-square	4398.824
	df	300
	p	*p*<.001

By reflecting the characteristics of the items converged on the four factors, each factor was named safety prevention, safety knowledge, safety preparation, and safety protection. Table 4 shows the contents of the items for each factor of the finally selected life safety awareness scale.

Table 4. Contents of items by factor in the safety awareness scale

Factor	Item No.	Item Content
Safety Prevention	1	Be sure to check the normal operation of the electric automatic switch (breaker) on a regular basis.
	2	Set a day of the week to check for gas leaks.
	3	Metal waste bins are provided in the laboratory and laboratory.
	4	Place mats in bathrooms and toilets to prevent slipping.
Safety Knowledge	5	Electrical outlets use only 80% of their rated capacity.
	6	When purchasing refrigerated foods, make sure they are stored at 0-10˚C.
	7	Keep a list of allergens and always pay attention.
Safety Preparation	8	When entering the tidal flat, prepare a waterproof bag with communication equipment such as a mobile phone and a whistle.
	9	Do not walk alone in the alleyways.
	10	To protect yourself, prepare a self-defense spray or whistle in advance.

	11	Join the missing person search by looking at the missing person finder app with interest.
	12	If you are exposed to risk and experience stress or trauma, immediately request psychological treatment from a WEE class or a specialized institution.
Safety Protection	13	When handling a machine tool, be sure to receive sufficient training on how to operate it in advance.
	14	When conducting an experiment or practice, it is carried out only according to the correct procedure and method.
	15	When conducting an experiment or practice, wear a training uniform, mask, etc., and follow the guidance of the teacher.
	16	Know exactly how to use butane gas or burners while camping or outdoors.
	17	In the event of an electric shock, immediately turn off the power and report it to 112 or 119.
	18	If a strong acid or basic solution gets on your skin or clothing, wash it off with plenty of water.
	19	Do not shake or move a person who has fallen in an accident.
	20	If a shard of glass gets stuck in your body during an experiment or practice, do not remove it forcibly and immediately go to the health room or hospital.
	21	Discard food that has been stored for a long time and has spoiled.
	22	If a stranger approaches you through social media or mobile messenger, you should be vigilant.
	23	Part-time jobs that offer high-yield guarantees as bait should be wary.
	24	After using tools or laboratory equipment, be sure to put them back in their place.
	25	Knives or scissors used to prepare food are safely put back in place after use

Table 5 shows the reliability, mean, and standard deviation of the last 25 items of the safety awareness scale.

Table 5. Item characteristics and reliability of the final life safety awareness scale

Factor	Item No.	M		SD	Cronbach's α	
Safety Prevention	1	3.03	3.01	.831	.84	.592
	2	2.89		.886		
	3	2.98		.806		
	4	3.13		.82		
Safety Knowledge	5	2.68	2.72	.794	.92	.632
	6	2.73		.845		
	7	2.74		1.109		
Safety Preparation	8	3.03	2.77	.883	1.00	.814
	9	2.83		.965		
	10	2.51		1.119		
	11	2.66		1.038		
	12	2.83		.988		

Safety Protection	13	3.38	3.55	.708	.58	.885
	14	3.46		.607		
	15	3.55		.572		
	16	3.49		.63		
	17	3.52		.598		
	18	3.59		.598		
	19	3.53		.58		
	20	3.62		.537		
	21	3.67		.525		
	22	3.56		.598		
	23	3.7		.501		
	24	3.57		.556		
	25	3.55		.569		
Overall Average		3.21		.75		.876

For each sub-factor, the item average distribution was 2.51-3.67, and the standard deviation distribution was .501-1.119. Among them, the average of safety protection was the highest with 3.55, and the average of safety knowledge was the lowest with 2.72. The standard deviation was not biased toward extreme values, indicating that the distribution of items on the scale was appropriate. The distribution of the reliability coefficient (Cronbach's α) for each factor was .592-.885, and the overall mean reliability coefficient was .876, showing a good level.

Table 6 shows the one-dimensionality analysis results for each factor of the final safety awareness scale. For each factor, if the eigenvalues of all components, except the first component, are less than 1, or if two or more eigenvalues are 1 or more, the difference between the first factor and the eigenvalues is 2 or more, one-dimensionality can be considered suitable [20]. The one-dimensionality of the items for each factor was supported according to the fitness criteria.

Table 6. One-dimensionality by factor of life safety awareness

Factor	Eigenvalues												
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
F1	1.841	.892	.863	.404									
F2	1.838	.67	.492										
F3	2.839	.769	.664	.417	.311								
F4	5.728	1.164	1.011	.825	.688	.647	.583	.503	.488	.431	.39	.309	.233

(Fl=Safety Prevention, F2=Safety Knowledge, F3=Safety Preparation, F4=Safety Protection)

4.4. Validity of Life Safety Awareness Scale

In order to verify the validity of the safety awareness scale, it was divided into content validity, construct validity, and cross validity, and variously reviewed. Criteria-related validity was excluded because there was no similar standard for living safety awareness for high school students. Content validity was thoroughly reviewed

during the preliminary survey and preliminary examination for the selection of appropriate items.

For construct validity verification and cross-validation, the total 506 respondents of this test were divided into a search group and a crossover group by 253 people, respectively, and how much of a difference there was in the life safety awareness measurement model was analyzed. Convergence and discriminant validity of the search and crossover groups were verified, and the fit of the measurement model was analyzed.

In Figure 2, the convergent validity and discriminant validity of the search group factors are presented as path diagrams.

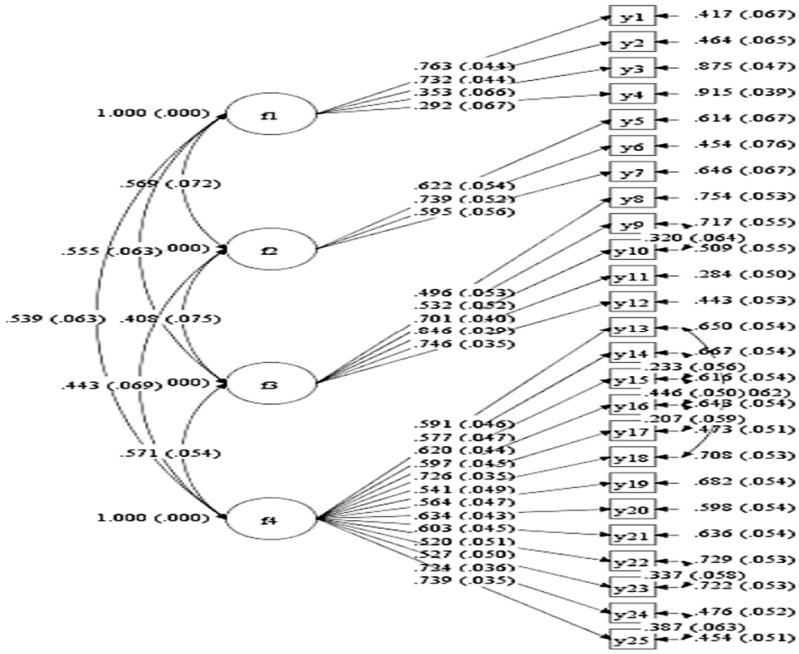

Figure 2. Path diagram of the search group factor analysis model

Although the loading of two items in factor 1 is less than the general standard value, it was not removed because it could be used as a factor component item if the factor was distinct and did not affect the goodness of fit of the measurement model [19]. The covariance between factors presented in Figure 2 is a standardized estimate, and it can be said that all factors are correlation coefficients [21]. The value of the correlation coefficient between the four factors was .443-.569, which was smaller than the reference value of .9, indicating good discriminant validity.

Table 7 shows the fit analysis results of the search group life safety awareness measurement model. The goodness of fit of the model in the search group was $\chi(262)$ =455.497, CFI =.916 RMSEA =.054, SRMR =.057 and was found to be well satisfied [14].

Table 7. Appropriateness of life safety awareness measurement model in the search group

χ^2	*df*	*p*	CFI	RMSEA	SRMR
455.497	262	<.001	.916	.054	.057

In Figure 3, the convergence and discriminant validity of the crossover group factors are presented as a path diagram. Although some loads in factor 1 were smaller than the reference value, they were not removed under the same conditions applied in the search group [21]. The covariance between factors presented in Figure 3 is a standardized estimate, and it can be said that all factors are correlation coefficients [14]. The value of the correlation coefficient between the four factors was .401-.621, which was smaller than the reference value of .9,

indicating good discriminant validity.

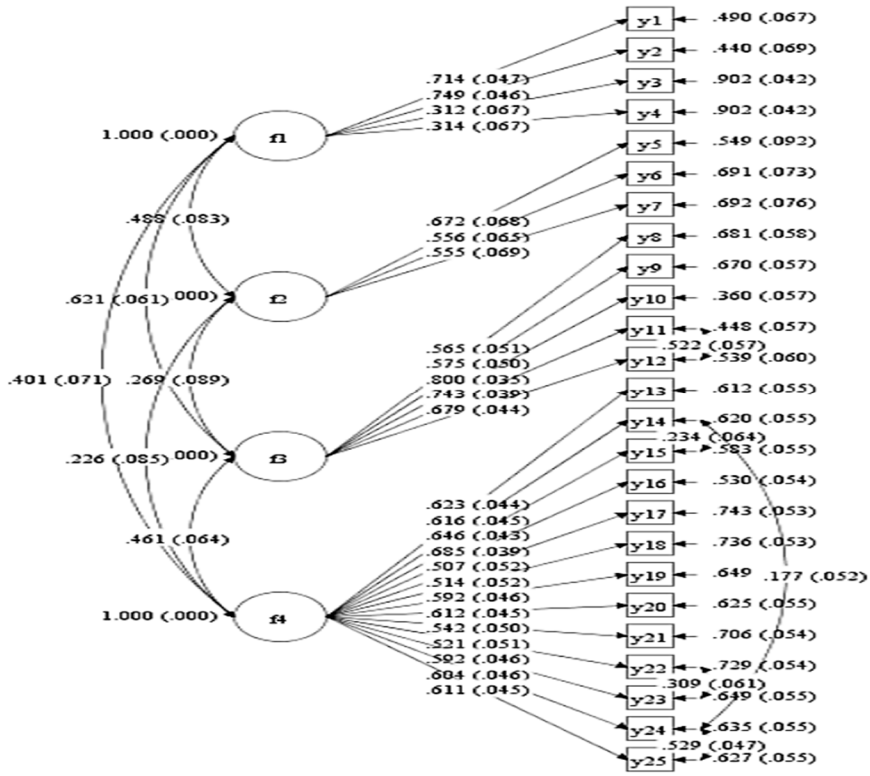

Figure 3. Crossover group factor analysis model path diagram

The construct validity of the safety awareness scale was additionally verified through correlation analysis between crossover group factors. The correlations of safety prevention, safety knowledge, safety preparation, and safety protection were all positively significant. In particular, safety preparation and safety prevention show the highest correlation with .433. Table 8 shows the correlation matrix between safety prevention, safety knowledge, safety preparation, and safety protection in the cross-group.

Table 8. Crossover group correlation

Factor	F1	F2	F3	F4
F1	1			
F2	.338***	1		
F3	.433***	.219***	1	
F4	.307***	.173**	.403***	1

***p<.001 (Fl=Safety Prevention, F2=Safety Knowledge, F3=Safety Preparation, F4=Safety Protection)

Table 9 shows the fit analysis results of the cross-group life safety awareness measurement model. The fit of the model in the search group was $\chi^2(264)$ =459.418, CFI =.905, RMSEA =.054, and SRMR =.057 and was satisfactorily satisfied.

Table 9. Fit of crossover group life safety awareness measurement model

χ^2	*df*	*p*	CFI	RMSEA	SRMR
459.418	264	<.001	.905	.054	.057

4.5. Cross Validation

Cross-validation was verified as appropriate because the measurement model fit criteria of the search group and the crossover group were similar to each other. A comparison of the identity of the search group and the crossover group is presented in Table 10. The identity of the two groups were verified because the increased χ^2 compared to the increased degrees of freedom was not large and the point estimate of the root mean square error of approximation (RMSEA) met the appropriate reference value [21].

Table 10. Results of analysis of identity between the search group and the crossover group

Model	*df*	χ^2	$\triangle df$	$\triangle\chi^2$	RMSEA
Baseline Model	538	1240.427			.051
Measurement Weights	559	1264.781	21	24.354	.050
Structural Covariance	594	1331.098	35	66.317	.050
Measurement Residuals	619	1420.459	25	89.361	.051

4.6. Mean and Standard Deviation Interpretation

The average of factors related to safety knowledge composed of 3 items (M=2.72) was the lowest, and the average of factors related to safety knowledge composed of 13 items (M=3.55) was the highest. This can be evaluated positively in the sense of a high safety awareness to take care of oneself and the surroundings so that there is no danger on a regular basis. However, the safety knowledge of using the rated capacity of an electrical outlet or keeping food at an appropriate temperature when storing food in the refrigerator and always paying attention to food that causes allergies is somewhat low. It is necessary to increase attention and interest in life safety knowledge through repetition and experiential learning. In the safety preparation factor, the average (M=2.51) of the question 'To protect yourself, prepare a self-defense spray or whistle in advance.' was the lowest and the standard deviation (SD=1.119) was the highest. Safety awareness regarding the use of self-defense products is low, and it is somewhat ubiquitous to the extreme. It is necessary to strengthen safety education on how to use self-defense products that can be used as a legal tool for students to protect themselves. On the other hand, the average (M=3.67) of the question 'discard spoiled food immediately after storage for a long time' was found to be the highest. This is interpreted as the effect of repeated education on food poisoning from a young age.

4.7. Analysis of Interindividual Differences in Life Safety Awareness

The overall average value of life safety awareness was 2.90 for male students and 3.13 for female students, indicating that the average of female students was high. Both male and female students showed the highest mean of safety protection factors and the lowest standard deviation. In the safety awareness analysis by factor, male students showed the lowest average value in safety preparation and female students in the safety knowledge factor, respectively, confirming the need for customized life safety education considering individual

differences. In the chart of Figure 4, you can visually confirm the difference between the genders in the awareness of safety in life.

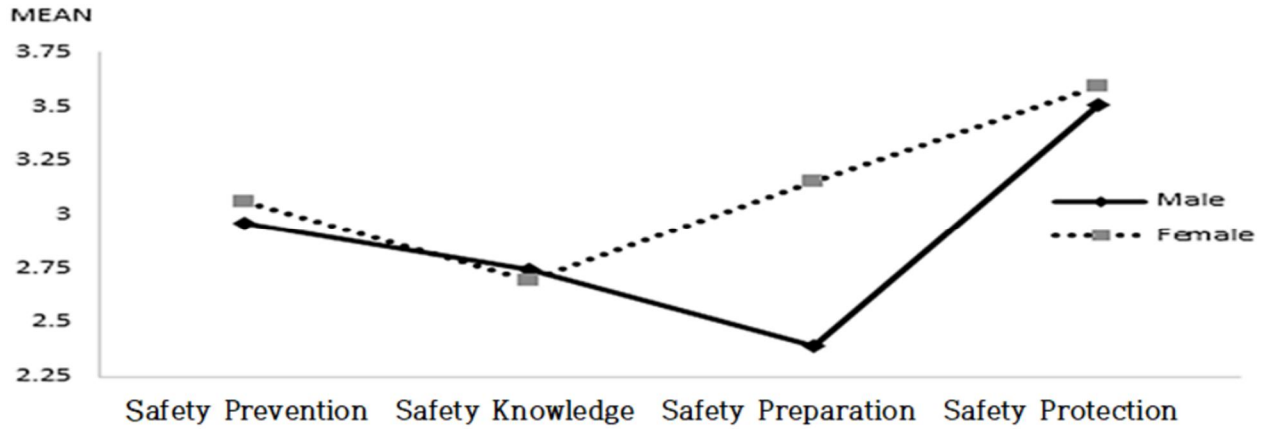

Figure 4. Analysis of gender individual differences in life safety awareness chart

There was a marked difference between male and female students in safety preparation. It is interpreted that there is a difference in safety awareness about the use of self-defense products or protective equipment for safety preparation between male and female students. The items of safety preparation factors, "Prepare a self-defense spray or whistle in advance to protect yourself," and "Do not walk alone in the alleys as much as possible" may have a more positive effect on the safety awareness of female students than male students.

In the result of checking the Greenhouse-Geisser value of the Mauchly sphericity test for intra-individual effect test presented in Table 11, the gender difference in life safety awareness was significantly F=74,995.

Table 11. Analysis of gender individual differences in life safety awareness

Source	*SS*	*df*	*MS*	*F*	*p*
Life Safety Awareness × Sex	50.240	2.719	18.471	74.995	<.001

The interaction effect was not statistically significant in each of the F and p values by grade level and academic achievement.

5. DISCUSSION AND CONCLUSION

The ability of students to self-diagnose their own safety awareness suitability can help not only to cure insensitivity to safety, but also to maintain safety awareness and to change desirable knowledge, skills and attitudes about safety. In addition, as the starting stage for setting learning goals in safety education for each life cycle considering individual differences of students, understanding the level of safety awareness of students should be preceded. However, a scale with reliability and validity to diagnose high school students' life safety awareness has not yet been developed.

In such a awareness problem, the purpose of this study was set to develop and validate a scale that can measure high school students' life safety consciousness and to analyze the individual differences in life safety awareness by gender, academic achievement and grade level. To this end, a survey was conducted three times from April 25 to June 10, 2022, targeting 834 students (male: 466, female: 368) in 1st, 2nd, and 3rd grade high schools located in △△ city, Jeollabuk-do. Through descriptive statistics and exploratory and confirmatory factor analysis, a life safety awareness scale for high school students whose reliability and validity have been verified

was developed. Based on the interindividual differences analysis, although there was a difference between genders in life safety awareness, there was no difference by grade level and academic achievement. Although this study is insufficient, it is significant in developing the first scale that can measure the life safety consciousness of high school students whose reliability and validity have been verified. Some additional significances and implications of the study results are as follows.

The components of the high school life safety awareness scale presented as the first research question consisted of 25 items and 4 sub-factors such as "safety prevention", "safety knowledge", "safety preparation", and "safety protection". The items of each factor were limited to the high school life safety education field presented in the 7 standards for school safety education in consideration of the safety awareness measurement by life cycle. Questions about the characteristics and hazards of favorite foods, the safe use of electrical and electronic products, understanding of safety rules for experiments with practice and proper use of protective equipment, how to deal with injuries in sports and leisure activities, and how to deal with disappearance, kidnapping, and missing children were explored and sub-factors were derived accordingly. In the three-stage survey, including preliminary survey, preliminary test, and main survey, emphasis was placed on the development of various items in consideration of the diversity of students and life safety accidents. This is in line with the view that the selection of reliable and valid items and sub-factors is of utmost importance in order to develop a generalizable scale. "Join the missing person search by looking at the missing person finder app with interest," which asks about basic competencies for safety awareness in a community living together, which is the core value of safety education in the item characteristic analysis. It was found that the response rate of the questions was rather low. It can confirm the necessity of establishing a stronger life safety education that enables students to develop basic competencies as democratic citizens who can protect their own safety and take care of others as subjects of future society.

As the second research question, significance was confirmed in the reliability and validity analysis of the scale conceptualized with 25 items and 4 factors. Therefore, the scale developed in this study is a validated scale for diagnosing high school students' life safety consciousness, implying the possibility of generalization. In the correlation analysis between factors in the cross-group, safety preparation shows a high correlation with safety prevention. Rather than responding after a life safety accident, various preventive education measures are needed to predict and prepare for accidents.

As a third research question, in the analysis of individual differences in life safety awareness scale factors, there was a difference between genders, but there was no difference by grade level and academic achievement. These research results are significant in providing the necessary and rationale for customized safety education considering gender individual differences in students' life safety education. The overall average value of life safety awareness was higher among female students than male students. In the average value of each factor, male students had the lowest level of safety comparison and female students had the lowest level of safety knowledge. In the mean of safety preparation, female students were higher than male students. In life safety education, safety education-related contents need to be treated more importantly for male students in preparation for safety accidents and safety knowledge for female students.

In conclusion, this study is significant in that it developed the first validated scale in a situation where there is still insufficient research on the development of high school life safety awareness scale, verified the possibility of generalization, and laid a basic and objective basis for this field. In addition, the safety awareness scale developed in this study can be used as a checklist as a tool to measure the safety awareness of high school students in the safety education process by life cycle. Despite the results of these studies and their educational value, we would like to suggest the following limitations and future research tasks.

First, the high school life safety awareness measurement tool developed in this study is difficult to apply to elementary and middle school students. Based on the scale developed in this study, it is expected that the safety awareness scale for each life cycle will be developed, the validity of which has been verified according to the level of each school level presented in the safety education curriculum.

Second, many questions selected to develop a scale suitable for diagnosing high school life safety awareness by life cycle were deleted in the process of factor analysis and validation, so various types of safety accidents could not be reflected in the questions. In line with the complex and rapidly changing times and the diversity of life safety accidents, it is necessary to restructure the life safety awareness scale by reflecting the reality.

Third, it may be difficult to apply the results of this study to all high school students as the sample of the research subjects is limited to some regions.

Fourth, in a previous study by S. B. Lee and H. S Kong (2021), it was reported that high school students had a low awareness of fire and disaster prevention safety. The results of this study also showed that the safety awareness for the prevention of safety accidents was lower than the overall safety awareness average. It is necessary to develop a safety accident prevention education program in which knowledge and experience are appropriately fused so that unconscious prevention habits can be cultivated through repeated learning on the causes and prevention methods for each type of safety accident.

Fifth, based on the results of this study, it is necessary to analyze the potential profile of students' life safety awareness. Analysis of potential profile groups considering individual differences will increase the effectiveness of customized life safety education for students.

In school safety education, by reinforcing repetitive learning tailored to each life cycle and developing effective learning materials and methods, the UN's banner of "all disaster safety comes from school" should be the basic direction of life safety education in schools.

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