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Risk Perception and Safety Knowledge of Scuba Divers

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Abstract

This study was aimed to identify a study on risk perception and safety knowledge and awareness of scuba diver. In order to achieve this purpose, a total of 310 customers over the age of 20 were selected as study participants form diving pools and dive resort in Seoul, Gyeonggi, Gangwon, Gyeongsang area using the convenience sampling method. However, only data from 295 customers were used after screening the data for reliability. The instrument for data collection was a questionnaire, and descriptive statistics, inter-item consistency reliability, t-test, ANOVA, post hoc test, correlation analysis, pearson chi-square test were conducted on the data using the SPSS 21.0 version statistical package program. The followings are the results: First, risk perception differs significantly according to age, education level, occupation and participation period. Second, participation period and safety knowledge have positive correlation.

▸Keyword: Scuba, Diving, Risk Perception, Safety, Knowledge

I. Introduction

Scuba diving is one of the fastest growing marine sports worldwide worth billions of dollars [1, 2]. Whereas more and more people become divers, appropriate measures to respond to emergency during diving [3-5]. Accidents vary widely. To revitalize the scuba diving industry with that in mind, various efforts should be made to ensure security of scuba divers such as a measurement of changes in vital signs in waters [6, 7], analysis on the relation between diving experiences and the level of safety perception or knowledge [8, 9], improvement in club activities and response in emergency [10], and development in the policy and system for safety and leadership education [11]. In the deep water, oxygen inhaled while breathing in the water causes addiction symptoms and nitrogen gas causes anesthetic symptoms. The deeper the water is, the more the divers suffer lower body temperature, nitrogen anesthesia symptoms, fear, panic, and cloud judgment leading to over-breathing. In order to prevent these safety accidents divers should comply with safety rules, learn knowledge, and be trained well enough. Scuba diving education institutions worldwide issue diving certification for those who finished the training course and only those certified can participate in diving activities [8]. An awareness of the importance of paramedic treatment in scuba diving not only protects oneself from an accident, disease, or danger but also, in emergency, prevents patients from suffering deeper pain or disability by giving the patients professional and efficient paramedic treatment. Further, it helps professional medical services and protects human lives [12].

The precedent and current domestic researches mostly deal with safety knowledge [5,13], safety standards [14],

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diving accidents [15], and risk perception [16]. Still, study on perception of risks divers may face, safety-related knowledge, or perception of treatment in emergency lacks. The effect of perceived risk and instructor trust on re-participation intentions in scuba diving[22]. Both correlation and regression analyses were performed to analyze self-administered surveys collected from 243 scuba diving license holders. The results of analyses were as follows: First, overall perceived risk was found to have negative effect on instructor trust. Among observed variables of perceived risk, personal risk had greater effect on instructor trust than physical risk. Second, overall perceived risk was found to negatively effect intention to re-participate, and the level of its effects among observed variables were as follows in the descending order of personal risk, social risk, and physical risk.

Thus, this study is to see how scuba divers understand risks and treatment in emergency during diving. It categorizes scuba divers into three levels and analyzes each group to provide a foundation data on risk perception and safety knowledge required for each diver level.

II. Methods

1. Subjects

The present research studies divers in their 20s using diving resorts and pools based in Seoul and provinces of Gyeonggi, Gangwon, and Gyeongsang. The survey was conducted from January 25, 2016 to May 24, 2016, for five months. The participant divers are classified into three grades according to the level of performance : Open water diver, Advanced diver, and Diver master (or Assistant instructor or Instructor or Trainer). For the data collection, 310 copies of questionnaire with convenience sampling which is non-probability sampling were delivered. Among the collected data, 15 invalid copies which include omitted or redundant answers were excluded and 295 or 95.8% survived for analysis.

2. Instrument

To meet the purpose of this study which is to find out scuba divers' risk perception, safety knowledge, and awareness of paramedic treatment in emergency, a questionnaire is used and the instrument is designed based on the existing precedent studies as <Table 1> shows.

Table 1. Questionnaire Content Indicators and Descriptions

Factor	Indicator	Question Quantity	Question Type
General Characteristics	Gender	1	Multiple choice
	Age	1	
	Final education	1	
	Occupation	1	
	Diving level	1	
	Experience years	1	
Risk Perception	Functional	4	5 Likert scale
	Temporal	2	
	Bodily	4	
Safety Knowledge	On water depth	3	5 Likert scale
	Volume change		
	Physical change	2	
	Paramedic method	2	
	Knowledge in paramedic treatment	6	
	Emergency response	6	
Total		35	

2.1 General Characteristics and Participants

For general characteristics, the questions are divided into 6: Gender, age, final education, profession, diving level, and the period of diving experience. Each indicator is technically classified as male and female for gender; 20s, 30s, and over 40s for age; high school, college enrollment/graduation, university enrollment/graduation, and graduate school enrollment/graduation for final education; student, production worker, professional, self-employed, and others for occupation; open, advanced, and master for diving level; and five grades from less than one year through over ten years of the experience.

2.2 Risk Perception

The ten questions about risk perception of divers are reconstructed based on a questionnaire used by Jung, Jin-bae (2012) to be more becoming. They are designed to know functional (4), temporal (2), and bodily (4) risks and, for risk perception, the higher Likert scale out of 5, the higher the awareness level of risks.

2.3 Safety Knowledge

The 19 questions related to safety knowledge are made based on survey questions used by Kang, gyong-soon (2012). The questionnaire includes a volume change (3), physical change (2), treatment method (2), knowledge in treatment method (6), and emergency response (6). For the knowledge in treatment method, the higher Likert scale out of 5, the higher the awareness level of risks.

3. Verification of the Questionnaire's Validity and Reliability

3.1 Validity

Industry experts contributed to examining the validity of the questionnaire instrument used for this study which is based on precedent studies including three senior scuba trainers, four instructors, three college professors from departments of leisure sport, paramedics, and emergency management each. Their advice helped to redesign questions.

3.2 Reliability

The reliability of the instrument used for this study was verified with Cronbach's α. Inter-item consistency reliability was corroborated and <Table 2> shows the results.

Table 2. Reliability Analysis by Factors

Classification	Question Quantity	α coefficient
Risk Perception	10	.884
Safety Knowledge	19	.977

As a result of the analysis of Cronbach's α, a reliability quotient, risk perception marks at .884 and safety knowledge at .977 which means a high reliability as <Table 2> shows.

4. Study Procedures

The researcher of this study visited in person diving resorts and pools located in Seoul and provinces of Gyeonggi, Gangwon, and Gyeongsang for five months between March 25 and May 14, 2016 and explained the purpose of the study and caution to the managers and staff. Then, under the permission of the staff members and study participants collected by convenience sampling, questionnaire was distributed to them and answered by themselves. Upon being finished, the survey answers were immediately collected by the researcher.

5. Data Processing

This study uses SPSS 21.0 Program for data analysis. In all statistical analyses, significance level is $p<.05$ and t-test and ANOVA are used in verifying general characteristics about risk perception and safety knowledge of scuba divers. For post-hoc, Scheffe test is implemented.

Correlation analysis is used in finding out the correlations between and among annual diving frequency, risk perception, and safety knowledge.

III. Results

<Table 3> shows a frequency percentage of diving depending on general characteristics of the subjects participated in this study.

Men (211 or 71.5%) go diving more often than women (84 or 28.5%). Those in their 20s (147 or 49.8%) dive the most followed by those in their 30s (95 or 32.2%) and those aged over 40 (53 or 18.0%). College students or graduates (110 or 37.3%) go diving the more often than university students or graduates (109 or 36.9%), high school graduates (50 or 16.9%), and graduate school graduates (26 or 8.8%). From an occupational point of view, students (120 or 40.7%) are the most frequent divers followed by professionals (85 or 28.8%), self-employed (41 or 13.9%), miscellaneous group (36 or 12.2%), and production workers (13 or 4.4%).

Beginners (153 or 51.9%) most frequently go diving while masters (86 or 29.2%) rank second in frequency followed by advanced divers (56 or 19.0%). As for the years of experience, divers with less than 1 year of experience (155 or 52.5%) go diving the most often followed by those who have dived for from 1 to less than 3 years (62 or 21.0%), over 10 years (32 or 10.8%), from 3 to less than 5 years (31 or 10.5%), and from 5 to less than 10 years (15 or 5.1%).

Table 3. General Characteristics

Classification		Number (N)	%
Gender	Male	211	71.5
	Female	84	28.5
Age	20-29	147	49.8
	30-39	95	32.2
	40 or older	53	18.0
Education	High School	50	16.9
	College	110	37.3
	University	109	36.9
	Graduate School	26	8.8
Occupation	Student	120	40.7
	Production worker	13	4.4
	Professional	85	28.8
	Self-employed	41	13.9
	Miscellaneous	36	12.2
Scuba Diving Level	Open water	153	51.9
	Advanced	56	19.0
	Master	86	29.2
Experience years	Less than 1 year	155	52.5
	1 to less than 3 years	62	21.0
	3 to less than 5 years	31	10.5
	5 to less than 10 years	15	5.1
	10 years or more	32	10.8
Total		295	100.0

1. Analyses on Scuba Divers' Risk Perception and Safety Knowledge

1) <Table 4> shows the difference from the point of general characteristics in risk perceptions scuba divers have.

As a result of analysis on risk perceptions divers have according to general characteristics, there is no significant difference regardless of gender, age, education, occupation, diving level, and the experience years.

Table 4. Difference in Risk Perceptions Among Scuba Divers

Classification		M	SD	t/F	p
Gender	Male	2.80	.84	.837	.403
	Female	2.71	.93		
Age	20-29	2.71	.84	.750	.473
	30-39	2.85	.96		
	40 or older	2.82	.79		
Education	High school	2.76	.81	.102	.959
	College	2.79	.83		
	University	2.75	.92		
	Graduate school	2.85	.95		
Occupation	Student	2.71	.81	2.068	.085
	Production worker	3.24	.76		
	Professional	2.91	.95		
	Self-employed	2.73	.87		
	Miscellaneous	2.59	.82		
Level	Open water	2.79	.83	2.403	.092
	Advanced	2.96	.91		
	Master	2.64	.90		
Experience years	Less than 1 year	2.79	.84	.663	.618
	1 to less than 3 years	2.78	.91		
	3 to less than 5 years	2.93	.87		
	5 to less than 10 years	2.71	.90		
	10 or more	2.58	.92		

2) Analyses on Scuba Divers' Safety Knowledge

<Table 5> shows the difference from the point of general characteristics in safety knowledge scuba divers have.

As a result of analysis on safety knowledge divers have according to general characteristics, there is no significant difference depending on gender. But there is statistically significant difference according to age: Aged 40 or older (M=4.45), 30's (M=3.78), and 20's (3.37) at a significance level of p<.001. Under the factor of education level, a significant difference exists: Graduate school graduates (M=4.43), High school graduates (M=3.88), University graduates (M=3.85), and College graduates (M=3.30) at a significance level of p<.001. Depending on occupation, there is a significant difference: Self-employed (M=4.32), Professionals (M=4.09), Miscellaneous workers (M=3.69), Production workers (M=3.57), and Students (M=3.23) (p<.001). Safety knowledge of divers statistically differs according to their diving level: Master (M=4.66), Advanced (M=3.42), and Open water (M=3.26) (p<.001). According to the experience years, divers have a different safety knowledge level: Those with more than 10 years of experience (M=4.90), 5 to less than 10 years (M=4.79), 3 to less than 5 years (M=4.06), 1 to less than 3 years (M=3.82), and less than 1 year (M=3.22) (p<.001).

2. Analyses on Correlations Between Measurement Factors

<Table 6> demonstrates the results of analysis on correlations between and among diving experience, risk perception, and safety knowledge.

The experiment finds that a very low negative correlation appears between the years of diving experience and risk perception, while a positive

Table 5. Difference in Safety Knowledge Among Scuba Divers

Classification		M	SD	Scheffe	t/F	p
Gender	Male	3.72	1.02		.529	.597
	Female	3.66	.80			
Age	20-29 (a)	3.37	.91	c>b>a	30.235	.000
	30-39 (b)	3.78	.85			
	40 or older (c)	4.45	.83			
Education	High school (a)	3.88	.86	a,c,d>b	14.718	.000
	College (b)	3.30	1.05	d>c		
	University (c)	3.85	.78			
	Graduate school (d)	4.43	.72			
Occupation	Student (a)	3.23	.87	c,d>a	18.672	.000
	Production worker (b)	3.57	.86	d>e		
	Professional (c)	4.09	.92			
	Self-employed (d)	4.32	.79			
	Miscellaneous (e)	3.69	.78			
Level	Open water (a)	3.26	.84	a,b>c	105.88	.000
	Advanced (b)	3.42	.68			
	Master (c)	4.66	.52			
Experience years	Less than 1 year (a)	3.22	.83	b,c,d,e>a	45.364	.000
	1 to less than 3 years (b)	3.82	.80	d,e>b		
	3 to less than 5 years (c)	4.06	.81	e>c		
	5 to less than 10 years (d)	4.79	.30			
	10 years or more (e)	4.90	.27			

***p<.001

correlation is seen between experience and safety knowledge. But risk perception is not statistically related to safety knowledge.

Table 6. Analysis Results on Correlations Between Diving Experience, Risk Perception, and Safety Knowledge

	Risk Perception	Safety Knowledge
Experience Years	−.165**	.558***
Risk Perception		−.035

**p<.01, ***p<.001

Ⅳ. Discussion

This is an empirical study conducted to see how different scuba divers are aware of risks and safety depending on factors.

As a result of analysis on the risk perception under the factor of general characteristics, there is no statistically significant difference according to gender, age, education, occupation, diving level, and experience years. This is consistent with a precedent study implemented by Jung revalidating the fact that general characteristics do not differ risk perceptions [18].

Analysis on the difference in safety knowledge among divers under the factor of general characteristics shows that there is statistically significant difference according to age, education, occupation, diving level, and experience years while no difference by gender. Looking at the results under the factor of age group, the older the divers are, the higher level of safety knowledge they have in their 40s, 30s, and 20s in order. This is consistent with the existing research by Kim, [17]. The present study results are also backed up by another precedent study saying that divers' occupation determines the level of safety knowledge[13]. As for education level, graduate school graduates have higher safety knowledge than high school graduates followed by university graduates and college students in order. Master divers have higher level of safety knowledge than advanced divers followed by beginners. From the point of experience years, those who dived for more than 10 years and 5 to less than 10 years have higher safety knowledge than those experienced for 3 to less than 5 years, 1 to less than 3 years, and less than 1 year. This revalidates a precedent study showing that the less divers experience, the less they know about safety [19, 20].

The results may conclude that the older they are, the higher their education level is, the higher their diving level is, and the longer they dive, the higher safety knowledge divers get. Correlation analyses are also made to understand relations between and among experience years, risk perception, and safety knowledge. As a result, there is a positive relation between experience years and safety knowledge but no correlation between experience years and risk perception as well as between risk perception and safety knowledge. It would be considered that there is a partial relationship between the risk perception level according to diving experience years and safety knowledge level. The period a scuba diver participated in diving is his/her own experience. Those who participated in diving for a long time have higher safety knowledge in proportion to the period. The existing researches show the same results [8, 18]. They also conclude that a long years of diving experience enables divers to get a higher safety knowledge level leading to a reduced exposure to danger.

As the analysis results show, long-experienced divers have higher risk perception and safety knowledge. Other studies back up the results highly skilled divers also have better knowledge than those with a lower skill [9, 10, 21]. A safety education should be implemented down the road based on such results for masters (instructors or trainers) for a safe scuba diving [21].

Ⅴ. Conclusions

The present study is an empirical research conducted to see how different scuba divers are aware of risks and safety. This research is focused on difference in risk perception, safety knowledge, and awareness of paramedic response among scuba divers. The conclusion is as follows:

There is no difference in risk perception among divers. But a difference in safety knowledge exists according to age, education, occupation, diving skill, and experience years. And experience years and safety knowledge have a positive correlation.

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