



Journal of Korean Society of Dental Hygiene

Original Article **The effects of CPR education on CPR knowledge and self-efficacy for dental hygiene students from different regions**

Received: 29 September 2017

Revised: 31 October 2017

Accepted: 3 November 2017

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ABSTRACT

Objectives: The purpose of this study is to investigate the knowledge and self-efficacy of dental hygiene students after cardiopulmonary resuscitation (CPR) education. **Methods:** A self-reported questionnaire was filled out by 260 dental hygiene students in the period between 5 November 2015 and 30 December 2015. The data analysis was performed by SPSS win 22.0 program for frequency analysis, chi-square analysis, and dichotomies multiple response analysis. **Results:** Self-efficacy and knowledge increased after CPR education. Most of the dental hygiene students are statistically significant difference in self-efficacy depending on CPR knowledge. **Conclusions:** Based on the results of this study, we suggest that the theory and practice of CPR, if taught to dental hygiene students, will boost their self-efficacy, and enable them to perform it correctly when faced with and emergency situation.

Key Words: CPR education, Dental hygiene student, Self-efficacy

Introduction

According to a survey by the Korean Statistical Information Service (KOSIS) in 2014, 47.7% of all deaths that occurred in Korea were due to three major causes: cancer, heart disease, and cerebrovascular disease. The prevalence of cardiovascular disease, the second highest after cancer, was 36.7 per 100,000 in 2004 but had increased to 52.4 per 100,000 in 2014, showing a remarkable increase of 42.7% over the decade [1]. Cardiovascular and cerebrovascular diseases, in particular, can result in deaths from cardiac arrest, but it is not always possible to predict their occurrences.

Cardiopulmonary resuscitation (CPR) is an essential, standardized first aid procedure followed in order to revive a person having a cardiac arrest. If a heartbeat is not recovered within the first 4-5 minutes of cardiac arrest, irreversible damage occurs in multiple organs of the body; even if the person recovers, significant aftereffects can persist. Therefore, it is crucial to initiate basic CPR as soon as it is suspected that a person is gone into cardiac arrest [2].

Recently, the occurrence of emergencies has increased in various patients during dental

procedures. Patients' anxiety about dental procedures, stress, asthma, and allergies can definitely result in an emergency situation in the dental office. Under emergency situations where immediate treatment is required, and there is no time to request for medical support or where immediate treatments are required to buy time for further medical support, appropriate initiation of treatment by dental staff can prevent potentially fatal medical accidents [3]. Quick and appropriate treatment provided by the dental staff enhances the survival of emergency patients, especially in cases of cardiac arrest. In order to increase the survival rate of cardiac arrest patients, The first witness who first arrived at the scene of sudden injury or illness must quickly diagnose that the patient is having a cardiac arrest, immediately start CPR, and know how to use an automatic defibrillator properly. In addition, prompt response of the emergency system, on-site treatment, and treatment after hospital admission must be provided [4].

However, current dental hygiene courses in Korea are not structured to provide appropriate education on how to deal with patients in cardiac arrest. Even if education is provided, it is a one-time education. Some institutions require the acquisition of an international first aid qualification certificate, but in reality, very few institutions require this additional training. Therefore, in general, it is difficult to provide prompt treatment and response to emergency patients. As shown in a previous study by Jung and Hur [5] suggesting that periodic repetitive training rather than a one-time training on CPR is needed to provide effective and persistent CPR to emergency patients, continuous and repetitive training will protect patients from unnecessary deaths.

Self-efficacy, on the other hand, is the main determining factor of human behavior. By definition, self-efficacy is the expectation and belief in one's ability to perform appropriate actions under certain circumstances [6], and a person with strong self-efficacy is more likely to attempt these actions persistently. Therefore, self-efficacy in performing CPR is a crucial factor in preventing unnecessary deaths. In previous studies by Park et al. [7] and Kim and Lee [8], self-efficacy increased after CPR training and CPR performance improved. Since CPR is often needed under unpredictable situations, it is crucial for the first person to witness a patient in cardiac arrest to perform accurate and prompt CPR. The person with a higher self-efficacy will be able to make a quicker judgment and provide CPR more promptly to save patients in cardiac arrest.

Previous studies on CPR for dental hygiene students focused on their knowledge, attitude, or educational effects [3,9,10], and studies on the association between knowledge and performance of CPR and self-efficacy often focused on nursing students [5,8,11].

In this study, we investigated the education and knowledge level regarding CPR in dental hygiene students, who will be healthcare providers in future, in order to understand the effect of CPR knowledge on self-efficacy and one's ability to perform CPR for patients having cardiac arrest in future clinical situations.

Methods

1. Study participants

A survey was carried out among dental hygiene students from 6 different universities in Seoul, Gyeonggi-do, Chungcheong-do, and Jeolla-do from November 1, 2015 to December 30, 2015. The informed consent document was approved by the Institutional Review Board (IRB : SM-201509-035-1) of S University.

After providing an explanation for the study. First-year students were excluded from the study as they focus on learning basic dental hygiene knowledge before learning how to interact with patients and deal with clinical situations. Therefore, sampling targets were second- to fourth-year students. The subjects of this study were 300 people who agreed to participate in the study by listening to the explanation of the purpose of the study and extracting it by convenience extraction method. Out of 300 initial questionnaires issued, data from 260 were analyzed after excluding incorrectly completed and incomplete ones.

2. Research tools

A structured questionnaire with close-ended questions was used as a research tool. The questionnaire consisted of 52 questions from the following assessment sections: 15 questions on CPR education experience; 15 questions on CPR knowledge; 17 questions on CPR self-efficacy; and 5 questions on personal information.

1) Assessment of CPR education experience

For assessment of CPR education experience, 15 selected questions from a previous study by Kim et al. [12] were used to create an assessment to evaluate CPR education status. For some questions with multiple responses in this section, a dichotomies multiple response analysis was used.

2) Assessment of CPR knowledge

For assessment of CPR knowledge, selected questions from a previous study by Cho [13] were used. Regarding careless responses (i.e. providing the same answer for all questions), the ratio of correct to incorrect answers was 9:6. The assessment consisted of 15 questions including 2 questions on theory, 11 questions on basic resuscitation, and 2 questions on advanced cardiac life support. For this part of the study, Cronbach's α was 0.76.

3) CPR self-efficacy

For the assessment of self-efficacy, selected questions from a previous study by Jung and Hur

[5] were used. The assessment consisted of 17 questions including 6 questions on recognition, 2 questions on reporting, 7 questions on responses and structure, and 2 questions on debriefing. A 5-point Likert scale was used, with 1 indicating a response of 'very unconfident (Timid)' and 5 indicating a response of 'very confident.' A higher score indicates higher CPR self-efficacy. For this part of the study, Cronbach's α was 0.927.

3. Statistical Analysis

The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) version 22.0. The general characteristics of the participants were calculated as frequencies and percentages using frequency analysis. Differences in CPR knowledge and self-efficacy based on CPR education experience were assessed using the t-test. The relationship between the degree of CPR knowledge and self-efficacy was assessed using chi-square analysis. Multiple regression analysis was performed to examine the mediating effect of self-efficacy and CPR education on knowledge level and to evaluate the variables that affect CPR knowledge level.

Results

1. General characteristics of the participants

Of the participants, 96.2% were female, and only 3.8% were male. The distribution of participants based on their year of study was as follows: 35.0%, 31.9%, and 33.1% for 2nd, 3rd, and 4th years respectively. Based on their age, 29.6% were aged 21-22 years, 32.3% were 23 years old, 5.0% were 24 years old, and 3.5% were in other age groups. The largest portion of the participants (55.0%) lived in Gyeonggi-do, followed by Seoul (19.6%), Chungcheong-do (11.9%), Jeolla-do (13.5%), and Incheon (3.1%). For the question asking whether a family member or relative was suffering from a cardiac disorder, 10.8% responded 'yes,' while 89.2% answered 'no' <Table 1>.

2. CPR knowledge and self-efficacy based on CPR education

In order to compare CPR knowledge and self-efficacy based on CPR education, an independent sample t-test was performed. The results showed that the average score of the knowledge increased from 8.78 to 9.50 for participants without CPR education experience to participants with CPR education, and this result was statistically significant ($t = 3.34, p = 0.001$). Similarly, regarding self-efficacy, CPR education resulted in a significant increase in the average score of the participants with CPR education (3.16) compared to the participants without CPR education (1.99) ($t = 17.14, p < 0.001$) <Table 2>.

Table 1. General characteristics

(N=260)

Characteristics	Division	N (%)
Gender	Male	10 (3.8)
	Female	250 (96.2)
Year of study	2nd	91 (35.0)
	3rd	83 (31.9)
	4th	86 (33.1)
Age	21	77 (29.6)
	22	77 (29.6)
	23	84 (32.3)
	24	13 (5.0)
	Other age groups	9 (3.5)
Residence	Seoul	51 (19.6)
	Gyeonggi-do	143 (55.0)
	Ghungeong-do	31 (11.9)
	Jeolla-do	35 (13.5)
Acquaintances with heart disease	Yes	28 (10.8)
	No	232 (89.2)

Table 2. CPR knowledge and self-efficacy according to experience of learning CPR

Experience of CPR education	Knowledge			Self-efficacy		
	Mean±SD	<i>t</i>	<i>p</i> *	Mean±SD	<i>t</i>	<i>p</i> *
Yes	9.50±1.43	3.34	0.001	3.16±0.46	17.14	<0.001
No	8.78±1.33			1.99±0.39		

*by independent t-test

3. Relationship of CPR knowledge and self-efficacy

In order to compare self-efficacy based on CPR knowledge, the participants are divided into 3 groups (Good, Fair, and Poor) based on the number of correct answers and on the average score for knowledge - which is 9.34 <Table 3>. In the 'Poor' group (0-7 correct answers), 40% showed low self-efficacy, and 60% showed high self-efficacy. In the 'Fair' group (8-10 correct answers), 23% showed low self-efficacy, and 77% showed high self-efficacy. Lastly in the 'Good' group (11-15 correct answers), 10.4% showed low self-efficacy, and 89.6% showed high self-efficacy. There was a statistically significant difference in self-efficacy based on CPR knowledge ($p<0.05$).

4. CPR knowledge and self-efficacy based on the year of study

Considering that the lowest average score and highest average score were 1 and 5 when calculating the average score for self-efficacy in each subject, the participants were divided into

two groups with 2.5 as a standard for high (>2.5) or low (<2.5) self-efficacy. There was no significant difference in CPR knowledge ($p=0.121$) and self-efficacy ($p=0.05$) based on the year of study <Table 4>.

Table 3. Relationship of CPR knowledge level and self-efficacy

Unit: N (%)

Level of knowledge	Self-efficacy		Total	χ^2	p^*
	Low	High			
Poor	10 (40.0)	15 (60.0)	25 (100.0)	8.482	0.014
Fair	43 (23.0)	144 (77.0)	187 (100.0)		
Good	5 (10.4)	43 (89.6)	48 (100.0)		

*by chi-square test

Table 4. CPR knowledge level and self-efficacy according to the year of study

Unit: N (%)

Year of study	Knowledge				Self-efficacy		
	Poor	Fair	Good	Total	Low	High	Total
2 nd	11 (12.1)	68 (74.7)	12 (13.2)	91 (100.0)	15 (16.5)	76 (83.5)	91 (100.0)
3 rd	10 (12.0)	59 (71.1)	14 (16.8)	83 (100.0)	26 (31.3)	57 (68.7)	83 (100.0)
4 th	4 (4.7)	60 (69.8)	22 (25.6)	86 (100.0)	17 (19.8)	69 (80.2)	86 (100.0)
$\chi^2 (p^*)$	7.304 (0.121)				5.996 (0.05)		

*by chi-square test

5. Relationship between CPR knowledge level and experience of learning CPR

<Table 5> shows the adjusted association of CPR knowledge level and experience of learning CPR. In 'Good' level of CPR knowledge, CPR knowledge have a significant relationship with experience of CPR education Odd Ratios (95% confidence intervals) was 4.876 (1.328-17.902).

Table 5. Relationship between CPR knowledge level and experience of learning CPR

Characteristics	B	SE	Adjusted OR	95% CI
Level of knowledge- fair*				
Experience of CPR education				
Yes	0.855	0.487	2.352	0.906-6.104
No (ref)				
Level of Knowledge- good*				
Experience of CPR education				
Yes	1.584	0.664	4.876	1.328-17.902
No (ref)				

* $p<0.05$ by multiple logistic regression analysis

CI: confidence interval; OR: odds ratio

Adjusted for age, grade, acquaintance disease, residence

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6. The effect of self-efficacy as a mediator on the relationship between CPR education and knowledge level

Assessing the effect of self-efficacy as a mediator on the relationship between CPR education and knowledge level using the verification method shown by Baron and Kenny [14] demonstrated significance between the independent variable and the mediating variable<Table 6>.

Table 6. Effect of self-efficacy as a mediator between CPR education and knowledge

Stage	I.V	D.V	B	SE	β	t (p)
1 (Channel a)	Education	Self-efficacy	1.173	0.068	0.730	17.146 (<0.001)
	F=293.979, p<0.001				adj. R ² = 0.531	

Discussion

CPR is a first-aid approach used to provide temporary maintenance of respiration and circulation after cardiac arrest, without depending on medication or medical devices. The survival rate of cardiac arrest patients given CPR by the first witness is 2 to 3-fold higher than that of patients not given CPR [15]. Cardiac arrest can occur anywhere, and therefore the CPR guideline was established by the American Heart Association (AHA) and American Academy of Science in 1966 in order to improve the survival rate of cardiac arrest patients and to standardize the CPR procedure. Since then, many countries have revised their guidelines regularly. In October 2015, the Korean International Liaison Committee on Resuscitation (ILCOR) published the “Korean CPR guideline” as a new CPR and emergency cardiovascular care protocol [4]. Improving the self-efficacy of dental hygiene students by providing theoretical and practical education according to the CPR guideline will improve their ability to perform CPR in emergency situations.

This study investigated the CPR education experience and knowledge level of dental hygiene students in order to understand the effect of CPR knowledge on their self-efficacy and ability to perform CPR on patients in cardiac arrest. Different aspects related to CPR education - including CPR education experience, knowledge, and self-efficacy assessments - were investigated in a cohort of 2nd, 3rd, and 4th-year dental hygiene students.

Fifteen questions were used to assess the effect of CPR education experience on CPR knowledge. Independent samples t-test of the knowledge scores for each subject showed higher knowledge score with CPR education experience. This result supports previous findings by Kim [16] where the scores were indifferent in experimental and control groups prior to CPR education and were significantly different after CPR education, and also the finding by Kim et al. [17] that CPR knowledge and performance had increased after CPR education. Seventeen questions were

used to assess the effect of CPR education on self-efficacy. Independent samples t-test of average self-efficacy scores for each subject showed 158% increase in self-efficacy with CPR education. This result is similar to the previous findings by Cho [18] in which the participants who received regular CPR education had higher self-efficacy to handle emergency situations than subjects who did not receive regular CPR education. Therefore, CPR education will have a positive effect on the improvement of CPR knowledge and self-efficacy of the students.

The higher the level of knowledge, the greater the gap in self-efficacy. Positive correlation between CPR knowledge and self-efficacy indicates greater impact of self-efficacy with increasing knowledge level. In a study by Chun et al. [19], correlations between CPR and knowledge, attitude, and self-efficacy were assessed in which the biggest positive correlation was shown for attitude. However, in this study, only knowledge and self-efficacy were assessed (focusing on education). Therefore, in future, a similar study should be performed focusing on the attitude and self-efficacy of participants.

In a study by Kim [12] focusing on CPR-related knowledge level and education status, the authors reported that many students were not aware of the importance of CPR by the first witness. Recognition of the emergency of cardiac arrest in patients is crucial, and most of the students (92.3%) in this study answered “no” to the question “have you ever witnessed cardiac arrest or respiratory arrest?”, indicating that majority of the students have no experience with handling emergency situations. Furthermore, 22% of the students were “not confident” to perform correct chest compression at an adequate rate for cardiac arrest patients. Considering the previous findings showing improved self-efficacy with increased CPR knowledge level, repetitive rather than one-time training for CPR should be provided to the students in order to improve their knowledge and self-efficacy, and eventually their ability to perform CPR.

For general characteristics, there was no significant difference in knowledge based on the level of study, but there was a significant difference in self-efficacy based on the level of study. The current curriculum for dental hygiene students in Korea does not include structured courses on CPR, and even the very few existing ones are one-time courses. Therefore, CPR knowledge did not improve even in students in higher grades. However, self-efficacy was improved in students in higher grades, and this is likely due to senior students having more general clinical knowledge and clinical practice experience, which gave them more exposure to CPR training.

In our data, there was a significant relationship between CPR knowledge and education. In detail, the effect of education was significant even after controlling for age, grade, acquaintance disease, residence. In other words, participants with education had higher levels of knowledge compared those without education.

For the effect of CPR education on knowledge level, self-efficacy “perfectly mediated” education

experience and knowledge level, using the verification method by Baron and Kenny [14]. In other words, education had a close relationship with self-efficacy and had an indirect effect on the subject's CPR knowledge level through self-efficacy.

The limitation of this study is that the effects of education and self-efficacy might be overestimated or underestimated because the subjects were not educated under the same conditions. For a more accurate assessment of self-efficacy based on CPR knowledge level, repetitive rather than one-time CPR training should be provided to dental hygiene students under the same conditions, and further studies should be performed to assess the outcomes after the training.

Conclusions

This study assessed the effects of CPR education on CPR knowledge and self-efficacy. The following are the conclusions of the analyses.

1. Out of 260 participants, 205 (78.8%) received CPR education. 71.4% of the participants received education from their school. Further, 60.4% had both theoretical and practical training, and 58.9% had training via demonstration through a manikins.
2. The average score of CPR knowledge (out of 15) was 9.34, and self-efficacy had increased by 158% in the participants with previous CPR education ($p < 0.001$).
3. A positive correlation of CPR knowledge with self-efficacy showed a higher self-efficacy with increasing knowledge level.
4. Self-efficacy demonstrated a perfect mediation effect of CPR education on knowledge level.

In conclusion, there was a significant difference in self-efficacy based on CPR knowledge in the majority of dental hygiene students, and a positive correlation was observed between knowledge and self-efficacy. Therefore, dental hygiene students - future dental hygienists who will provide primary healthcare services - should have both theoretical and practical (demonstration using a manikins) CPR training in order to improve their ability to resolve emergency situations.

Acknowledgements

This work was supported by the Sun Moon University Research Grant of 2016.

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