Hemşirelik Öğrencilerinin Crush Sendromu Bilgi Düzeyleri: Bir Müdahale Araştırması

Crush Syndrome Knowledge Levels of Nursing Students: An Intervention Study

Funda ÖZPULAT[1], Melike TAŞDELEN[2], Birsen MOLU[3]

[1]Selçuk University Akşehir Kadir Yallagöz Health School, Konya, fozpulat@selcuk.edu.tr (Sorumlu Yazar)

[2]Selçuk University Akşehir Kadir Yallagöz Health School, Konya, meliket@gmail.com

[3]Selçuk University Akşehir Kadir Yallagöz Health School, Konya, brslml@hotmail.com

ÖZET

Bu araştırma ile (1) hemşirelik öğrencilerinin Crush Sendromu bilgi düzeylerinin saptanması ve (2) bir müdahale programı ile Crush Sendromu bilgi düzeylerinin arttırılması amaçlandı. Yarı deneysel nitelikte yapılan bu araştırma 21 Ekim - 31 Aralık 2021 tarihleri arasında hemşirelik üçüncü sınıfta okuyan, Afet Yönetimi ve Hemşireliği Dersi alan ve araştırmanın ön test ve son test uygulamasına katılan 43 öğrenci ile tamamlandı. Araştırmacıların oluşturdukları bir olgu ve bu olguya temellendirilmiş "Crush Sendromlu Yaralıya Tıbbi Yaklaşım Algoritması (CSYTYA)" hemşirelik öğrencileri ile paylaşıldı ve algoritma üzerinden yaklaşımları doğru olarak işaretlemeleri istendi. Veriler, araştırmacılar tarafından literatür doğrultusunda oluşturulan "Öğrenci Bilgi Formu" ile toplandı. Verilerin değerlendirilmesinde bağımsız Gruplarda t Testi, One Way Anova Testi, bağımlı değişkenlerin değerlendirilmesinde ise Bağımlı Guruplarda t testi kullanıldı. Ön testte hemşirelik öğrencilerinin Crush Sendromu bilgi puanı aritmetik ortalaması 21.67±3.01, son testte 24.61±.62'idi. Ayrıca ön test ve son test Crush Sendromu bilgi puanları arasında istatistiksel olarak anlamlı fark vardı (p<.001). Hemşirelik öğrencilerinin büyük çoğunluğu (%86) daha önce Crush Sendromuyla ilgili ders aldığını belirtti. Crush Sendromuyla ilgili ders alan öğrencilerin bilgi puanları ön testte ve son testte daha yüksekti ve istatistiksel olarak anlamlı fark vardı (p<. 001). "Crush Sendromlu Yaralıya Tıbbi Yaklaşım Algoritması (CSYTYA)" nın özellikle Crush Sendromu bilgi düzeyi, uygulanan müdahaleler ve komplikasyonlara yaklaşım konularında etkili olduğu belirlendi. Yapılan bu araştırma çoğunlukla göz ardı edilen Crush Sendromu bilgi düzeyi ve yaklaşımın uygulanan müdahalelerle iyileştirilebileceğini göstermiştir. Böylece Crush Sendromunda doğru, yeterli ve kaliteli hemşirelik bakımın uygulanmasında da etkili olunabilir.

Anahtar Kelimeler: Crush Sendromu, Hemşirelik Öğrencisi, Algoritma, Bilgi Düzeyi

ABSTRACT

This study had two objectives: (1) to determine the level of knowledge of nursing students about crush syndrome and (2) to use an intervention program to improve knowledge. This quasi-experimental pretest-posttest study was conducted between October 21 and December 31, 2021. The sample consisted of 43 third-grade nursing students who completed the "Disaster Management and Nursing" course. The researchers designed a case and presented participants with an "Algorithm for the Medical Approach to the Wounded with Crush Syndrome" (AMAWCS). They asked all participants to mark the correct approaches based on the algorithm. After the test, the participants had a significantly higher CSKF score (24.61±.62) than the pre-test CSKF score (21.67±3.01) (p<.001). Most participants reported that they had already attended a course on crush syndrome (86%). Participants who had already attended a course on crush syndrome had significantly higher pretest and posttest CSKF scores than those who had not attended a course (p<.001). The AMAWCS teaches nursing students about crush syndrome, associated complications, and medical interventions. Our results show that algorithms can help nursing students learn what crush syndrome is and how to treat it. In this way, we can ensure quality nursing care for the treatment of crush syndrome.

Keywords: Crush syndrome, nursing students, algorithm, level of knowledge

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INTRODUCTION

Disasters are natural or artificial hazards that cause serious disruptions to the functioning of a community that exceeds its capacity to cope using its own resources (Powers, 2010). There is a significant increase in the number and severity of disasters due to the rapid growth of the world's population, urbanization, and climate change. Disasters are global phenomena that threaten human life and health (Deeny & Davies, 2019; Sakashıta, 2014). Developed countries have experienced some terrible disasters recently. However, most disasters still occur in developing countries, where economic and political factors strongly affect preparedness and response capacity (Deeny & Davies, 2019).

Disasters require immediate action, such as crush syndrome. The word "crush" literally means to squeeze or press something until it breaks into pieces. Although crush only describes a trauma, the term crush syndrome refers to a medical condition including numerous surgical and medical signs and symptoms (hypovolemic shock, acute kidney failure, hyperkalemia, heart failure, respiratory failure, infections, etc.) due to rhabdomyolysis caused by trauma (Sever et al., 2021). The incidence of crush syndrome is 2% to 5% of all injuries (Sever et al., 2021).

The critical skillset to assess, manage, and treat victims under the rubble is essential to a successful outcome. Removing a victim from underthe rubble after an earthquake, the first admission to the hospital and the medical follow-up are of great importance in reducing mortality (Akdam & Alp, 2015). Nursing care plays a key role in detecting signs and symptoms, planning treatment and care, and monitoring the effectiveness of treatment (Bitek et al., 2016). However, most nurses or nursing students know little about crush syndrome because neither undergraduate courses nor in-service training programs address it adequately.

Nurses' knowledge and competence are critical in disasters because, in a disaster, an overwhelmed health care system could quickly deteriorate into a state of chaos. The more nurses know about crush syndrome and its diagnostic criteria, complications, and treatment, the better they are at executing interventions, providing care and treatment, and thus, reducing the risk of complications and mortality. Although some researchers focus on nurses' knowledge and views of disasters (Öztekin et al., 2015; Hindriyastuti et al., 2019; Khan et al., 2017; Kalanlar, 2018; Tzeng et al., 2016), there is no research investigating how much nurses know about crush syndrome. Therefore, this quasi-experimental pretest-posttest study had two objectives: (1) determining how nursing students know about crush syndrome and (2) using an intervention program to increase their knowledge level.

Research Question

1. What is the crush syndrome knowledge level of nursing students?
2. İs the applied intervention increase the knowledge level of nursing students

MATERIAL METHOD

Study Design
This study adopted single group pretest posttest reseach design.

Study Setting
This study was conducted in a nursing school in a district in the Central Anatolia Region of Turkey in the 2020-2021 academic year.

Sample Size
The study population consisted of 45 third-year students from a nursing school. No sampling was performed. Participation was voluntary. Inclusion criteria were (1) taking the "Disaster Management and Nursing" course, (2) taking the pretest and posttest, and (3) filling out the data collection forms completely. Two students were excluded from the sample because they failed to complete the data collection forms. Therefore, the sample consisted of 43 students.

Interventions and measurement

The researchers designed a case based on a literature review (Powers, 2010; Deeny & Davies, 2019; Sever et al., 2021; Akdam & Alp, 2015; Dilek & Atasoy, 2008) and developed an "Algorithm for the Medical Approach to the Wounded with Crush Syndrome" (AMAWCS). The nursing school has been offering the "Disaster Management and Nursing" course in the third year as an elective course for six years. The course is two hours a week. It is a theoretical course delivered by a lecturer for two class hours (45 minutes each) within the scope of "Crush Syndrome and Nursing Care" and "Emergency in Disasters." However, each class has been reduced to 30 minutes due to the COVID-19 pandemic.

The intervention started with delivering the "Crush Syndrome and Nursing Care" topic for two hours within the scope of "Emergency in Disasters." The topic consisted of six headings: (1) crush syndrome, (2) diagnosis, (3) complications, (4) primary-stage treatment, (5) secondary-stage treatment, and (6) nursing care practices. Afterward, a pretest was carried out. The researchers designed a case based on a literature review (Powers, 2010; Deeny & Davies, 2019; Sever et al., 2021; Akdam & Alp, 2015; Dilek & Atasoy, 2008) and presented participants with the AMAWCS on Microsoft Power Point. They asked all participants to mark the right approaches based on the algorithm. Participants moved on to the next stage (by adding a hyperlink to a slide) as they answered the questions correctly. When they gave the wrong answer, they were asked to review their choice. In the last stage, a posttest was carried out.
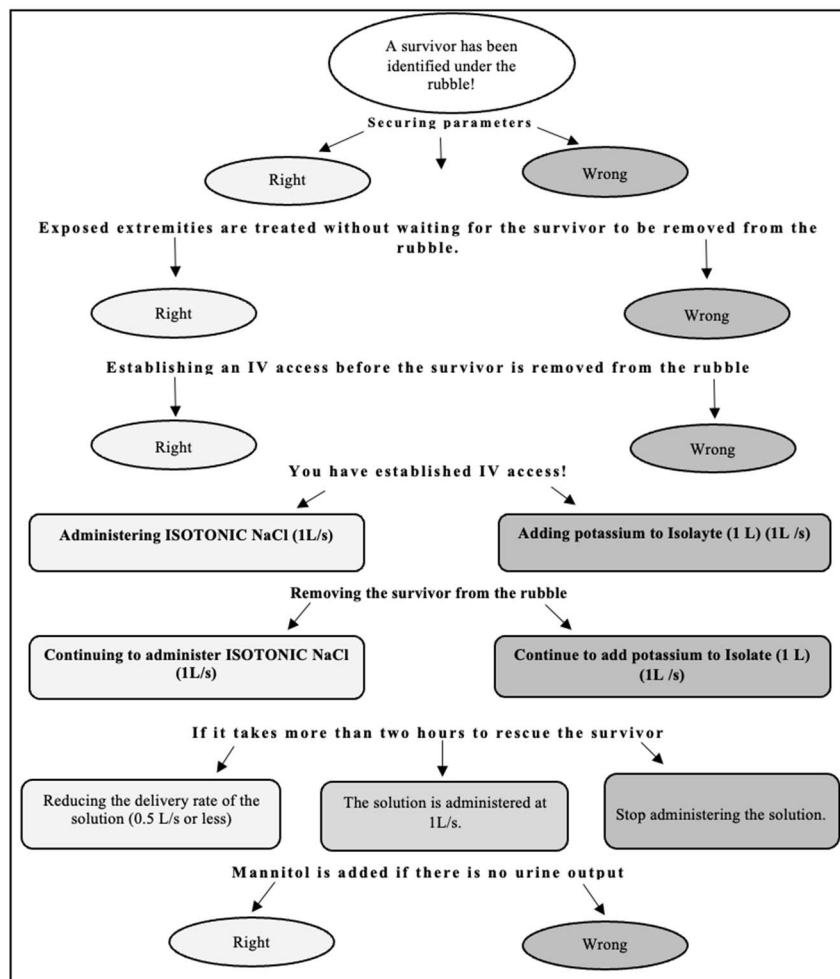

Figure 1. Crush Syndrome Flow Chart (Prior to Rescue)

Data collection form

The data collection form consisted of three parts. The first part had four items on age, gender, marital status, and family type. The second part had six items on crush syndrome (having taken a course on crush syndrome before, the name and duration of the course, having experienced a disaster before, the type of the disaster, and considering becoming a disaster nurse). The third part consisted of the "Crush Syndrome Knowledge Form" (CSKF) based on a literature review (Powers, 2010; Deeny & Davies, 2019; Sever et al., 2021; Akdam & Alp, 2015; Dilek & Atasoy, 2008). The third part had 25 questions, each calculated as one point.

Data analysis

The data were analyzed using the Statistical Package for Social Sciences (IBM SPSS Corp; Armonk, NY, USA, v. 22.0). The Kolmogorov-Smirnov and Shapiro-Wilk tests were used for normality testing. The results showed that the data were normally distributed. Numbers and percentages were used for descriptive statistics. Independent groups t-test and One-Way ANOVA test were used to analyze independent variables. Dependent groups t-test were used to analyze dependent variables. Cohen's d was used to evaluate the effect size.
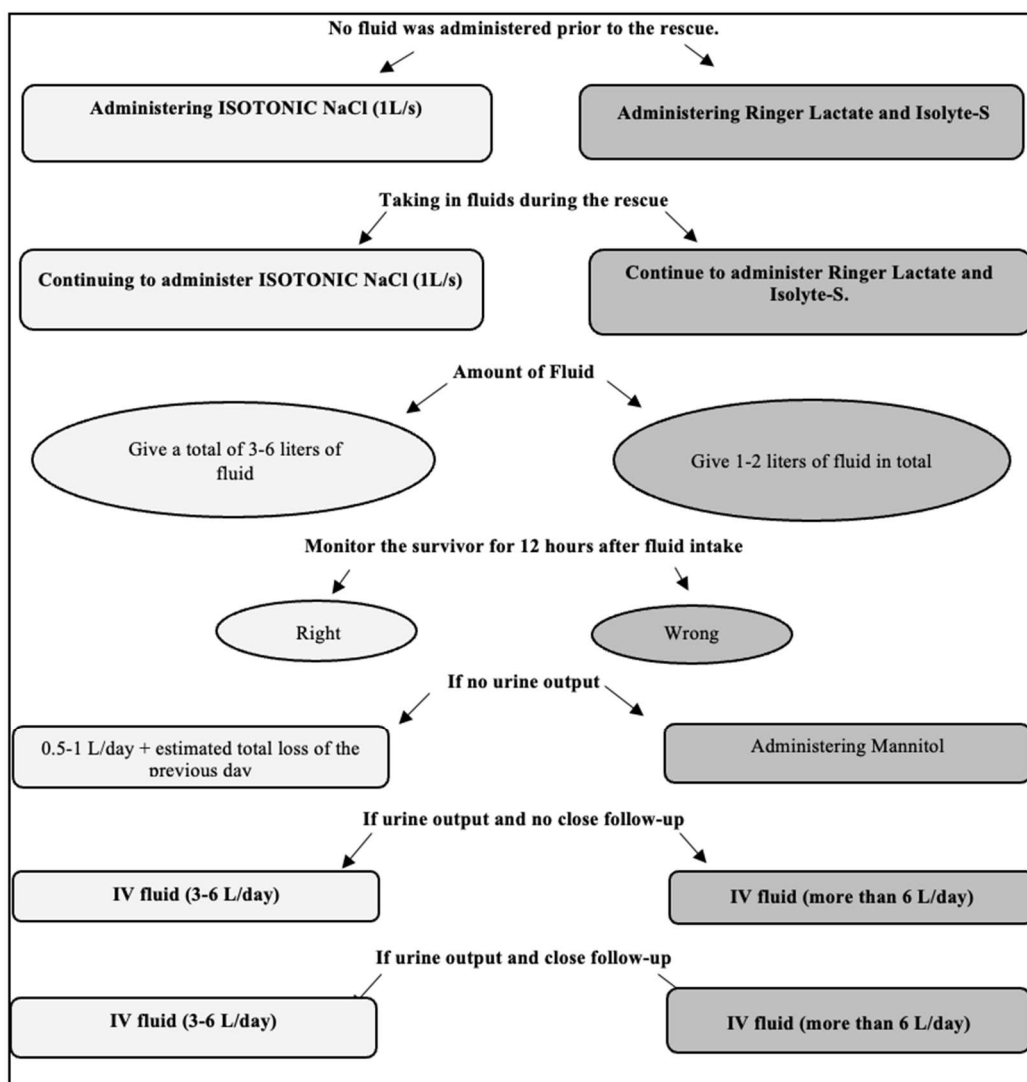

Figure 2. Crush Syndrome Flow Chart (After Rescue)

RESULTS

Half the participants were 21 years old (48.8%). Most participants were women (86%) and had nuclear families (88.4%) (Table 1).

Table 1. Sociodemographic Characteristics (n=43)

Age (years)	n (%)
19	1(2.3)
20	17(39.5)
21	21(48.8)
22	3(7.0)
23	1(2.3)
Gender	
Woman	37(86.0)
Man	6(14.0)
Family type	
Extended	5(11.6)
Nuclear	38(88.4)

Participants had a significantly higher posttest CSKF score (24.61±.62) than the pretest score (21.67±3.01) (p<.001) (Table 2). Cohen's d was 1.35, indicating that the intervention was effective.

Most participants stated that they had learned about crush syndrome in the "Internal Medicine Nursing" course (86%). Participants who had taken a course on crush syndrome before had a significantly higher pretest and posttest CSKF score than those who had not (p<.001). More than a quarter of the participants reported that they had experienced a disaster before (37.2%). The CSKF score of participants with no previous disaster experience was 21.29±3.42. Participants who had experienced a disaster before had a higher pretest CSKF score (22.31±2.09) than those who had not, but the difference was statistically insignificant (p=.289). More than half of the participants did not consider becoming disaster nurses, although they took the "Disaster Management and Nursing" (65.1%). There was no significant difference in pretest (p=.667) and posttest (p=.638) CSKF scores between participants who considered becoming disaster nurses and those who did not (Table 3).

Table 2. CSKF Scores (n=43)

CSKF Scores	Min-Max.	Mean	p*	Cohen's d
Pretest	10.00-25.00	21.67±3.01	**<.001**	**1.35****
Posttest	23.00-25.00	24.61±.62		

*Dependent groups t-test,
**The effect size value corresponding to each is shown as Cohen's d. Effect size Cohen's d (0.2–0.5 small effect, 0.5–0.8 moderate effect, > 0.8 large effect, > 1.2 very large effect and> 2.0 huge effect)

Table 3. The comparison of nursing students' characteristics of disaster nursing and their pretest-posttest knowledge scores (n=43)

Having taken a course on crush syndrome before	n(%)	Pretest	p	Posttest	p
Yes	37(86.0)	22.24±1.80	**<.001***	25.00±.00	**<.001***
No	6(14.0)	18.17±5.95		24.54±.65	
Having experienced a disaster before					
Yes	16(37.2)	22.31±2.09	.289*	24.63±.50	.871*
No	27(62.8)	21.29±3.42		24.59±.69	
Considering becoming a disaster nurse					
Yes	15(34.9)	21.40±4.45	.667*	24.67±.62	.638*
No	28(65.1)	21.82±1.93		24.57±.63	

* Independent groups t-test

In the pretest, most participants marked Statement 5 as "true" (76.7%). In the posttest, all participants marked it as "true." In the pretest, most than half the participants marked Statement 7 as "true" (60.5%). In the posttest, the majority of the participants marked it as "true" (95.3%). In the pretest, more than half the participants marked Statement 16 as "true" (60.5%). In the posttest, most participants marked it as "true" (90.7%). In both pretest and posttest, all participants marked Statements 4 and 14 as "false" (Table 4).

Table 4. Participants' Responses to Crush Syndrome-related Statements (n=43)

	Pretest n (%)	Posttest n (%)
1. The breakdown of muscle tissue that leads to the release of muscle fiber contents into the blood is called rhabdomyolysis.	39(90.7)	43(100.0)
2. Crush syndrome can cause acute kidney failure.	39(90.7)	43(100.0)
3. All earthquake survivors develop rhabdomyolysis.	42(97.7)	43(100.0)
4. Crush syndrome develops in all cases with rhabdomyolysis.	43(100.0)	43(100.0)
5. The most practical method for diagnosing rhabdomyolysis is to have a serum CK (creatinine kinase) five times the reference point.	33(76.7)	43(100.0)
6. Compartment syndrome occurs when excessive pressure builds up inside an enclosed muscle space in the body.	39(90.7)	43(100.0)
7. The normal pressure in the compartment is between 0 and 15 mmHg.	26(60.5)	41(95.3)
8. Compartment syndrome is a complication of crush syndrome.	41(95.3)	43(100.0)
9. The amount and color of urine should be monitored.	38(88.4)	43(100.0)
10. Peripheral vascular access is established while the patient is under the rubble.	37(86.0)	43(100.0)
11. Isotonic NaCl is used as IV fluid.	28(65.1)	42(97.7)
12. Body temperature must be maintained.	42(97.7)	43(100.0)
13. Potassium-containing solutions must be used.	42(97.7)	43(100.0)
14. The isolate-S solution should be used as IV fluid.	43(100.0)	43(100.0)
15. In case of no urine, the patient should be administered mannitol.	43(100.0)	43(100.0)
16. Even minor injuries can cause crush syndrome.	26(60.5)	39(90.7)
17. In the case of compartment syndrome, fasciotomy is a valid surgical indication.	29(67.4)	42(97.7)
18. The patient's state of consciousness should be monitored.	40(93.0)	43(100.0)
19. Signs of hypovolemic shock should be monitored.	40(93.0)	43(100.0)
20. A significant portion of those who survive from the rubble dies from hyperkalemia.	30(69.8)	42(97.7)
21. A patient with crush syndrome may need to undergo hemodialysis.	37(86.0)	43(100.0)
22. Early fluid therapy may prevent acute kidney injury.	38(88.4)	42(97.7)
23. Crush syndrome occurs due to natural and artificial disasters (earthquakes, traffic accidents, wars, etc.).	39(90.7)	43(100.0)
24. When the muscle is under pressure, it is called "Baromyopathy."	33(76.7)	40(93.0)
25. An important consequence of an increase in membrane permeability is an increase in intracellular (cytosolic) calcium.	30(69.8)	39(90.7)

DISCUSSION

This study investigated how much nursing students knew about crush syndrome and implemented an intervention to improve their knowledge.

Crush syndrome occurs during wars, mine collapses, and industrial and traffic accidents. However, crush syndrome is relatively common during major earthquakes (Sever et al., 2021). In the pretest, most participants marked Statement 23 as "true" (90.7%). In the posttest, all participants marked it as "true. "In the pretest, more than half the participants marked Statement 16 as "true" (60.5%). In the posttest, most participants marked it as "true" (90.7%). All nurses, especially disaster nurses, should know about crush syndrome and its treatment and care. Turkey is among the world's most seismically active zones. Therefore, Turkish nurses should have accurate and adequate information about crush syndrome. Research on large-scale earthquakes in Turkey shows that victims are likely to develop crush syndrome (Bulut et al., 2005; Akdam & Alp, 2015). The 1999 Izmit Earthquake (45 seconds with a moment magnitude of 7.4) is one of the most destructive earthquakes in the history of Turkey, causing 17.000 deaths and 43.000 injuries (Crisis Center of the Turkish Prime Ministry, 2000). Bulut et al. (2005) reported that two-thirds of patients admitted to Bursa Uludağ University Medical Faculty Hospital after the Izmit earthquake had crush syndrome. Akdam and Alp (2015) determined that the prevalence of crush syndrome among survivors of the 1999 Izmit Earthquake and the 2011 Van Earthquake was 1.5%. They also reported that about eight in ten survivors of the 1999 Izmit Earthquake and about four in ten survivors of the 2011 Van Earthquake underwent dialysis. These major earthquakes have provided Turkey with significant experience in terms of what interventions to apply to the victims under the rubble (Aydın & Altuntaş, 2019). Nurses know little about crush syndrome, although they may encounter it at any time during disasters. There is relatively a large body of research on nurses' and nursing students' knowledge or views of disaster nursing (Öztekin et al., 2015; Hindriyastuti et al., 2019; Khan et al., 2017; Kalanlar, 2018; Tzeng et al., 2016). However, this was the first study to investigate how many nurses and nursing students knew about crush syndrome.

An instructor delivered the "Crush Syndrome and Nursing Care" topic for an hour in the "Disaster Management and Nursing" course. Most participants stated that they had learned about crush syndrome in the "Internal Medicine Nursing" course they took in the second year (86%). Participants who had learned about crush syndrome had a significantly higher posttest CSKF score than those who had not (p<.001). Nurses should have the knowledge and skills to minimize the negative impact of disasters on society. Nurses should be prepared for emergencies, traumas, and disasters professionally and individually (Said & Chiang, 2020). Having previous education contributes positively to the level of knowledge about crush syndrome. Frequent repetition of this information in nursing education may contribute to the knowledge about crush syndrome. Therefore, we think that this study will contribute to the literature.

The "Disaster Management and Nursing" course at the school where the research was conducted was chosen by 59% of the 3rd grade students. However, most participants who took the course did not consider becoming disaster nurses. Disaster relief is a team effort where nurses contribute to healthcare delivery (Deeny & Davies, 2019). Nurses play a vital role in disaster preparedness and response (Khan et al., 2017). All nurses should have the basic skills to be prepared for and protect against disasters. Theoretical and practical training both during and after undergraduate years can help them develop those skills (Erdoğan, 2018). Nursing education in Turkey is not standardized. Therefore, Turkish universities offer different courses and subjects.Disaster nursing is mostly addressed in Emergency Nursing and Public Health Nursing, and to a lesser extent, within the subjects of other nursing fields (Özpulat & Kabasakal, 2018; Erdoğan, 2018). Differences between training programs on disaster nursing cause nursing students to feel inadequate. Nursing students know about the disasters that take or have taken place where they live, but they do not know much about other disasters that occur in other parts

PASHİD 2023; 4(2):46-56
JOPEHS 2023; 4(2):46-56

Paramedik ve Acil Sağlık Hizmetleri Dergisi
Journal of Paramedic and Emergency Health Services

Araştırma
Original Article

of the world and do not feel adequate about disaster nursing (Öztekinet al., 2015). The same applies to other countries as well. For example, although Australian nursing students think they are prepared for disasters and are willing to participate in the response, they do not believe they have the necessary knowledge and competence (Grimeset al., 2020). Research, in general, shows that nurses should be more prepared for disasters than they are (Hindriyastuti et al., 2019; Khan et al., 2017; Kalanlar, 2018; Tzenget al., 2016; Park & Kim, 2017; Alshehri, 2016; Ismailet al., 2016; Jiang et al., 2015). Nurses feel inadequate about responding to disasters (Nash, 2017). Educational interventions effectively improve disaster nursing knowledge and practice (Delnavaz et al., 2018; Najafi Ghezeljeh et al., 2019). Earlier research has shown that nursing students feel uncomfortable in disaster nursing and feel unprepared for disasters. Our results are consistent with the literature. All in all, universities should offer disaster nursing as a compulsory and separate course. In addition, Turkey does not have laws and regulations that clearly define the roles and responsibilities of disaster nurses, which is a major obstacle to improving disaster nursing in Turkey. This may also be why nursing students do not consider becoming disaster nurses or hesitate to take the "Disaster Management and Nursing" course. Therefore, the administration should review existing laws and regulations and specify the roles and responsibilities of disaster nurses. All universities should standardize the theoretical and practical basis of disaster nursing.

The goal is not only to get the injured with crush syndrome from under rubble but to save them. Therefore, healthcare professionals should act quickly and carefully (Aygin & Atasoy, 2008). For example, if the victim under the rubble has an exposed extremity, the nurse should establish intravenous access immediately and administer isotonic NaCl (1 liter/h) at the doctor's request. The nurse should also be aware that fluid infusion should be continued during the recovery (Sever et al., 2021; Sever, 2021). After the intervention, almost all our participants marked Statement 11 as "true" (97.7%). All participants marked Statement 14 as "false" both in the pretest and the posttest. Providing critical skills for assessing, managing, and treating the victim is essential to a successful outcome. Removing a victim from under the rubble after an earthquake, the first admission to the hospital and the medical follow-up are of great importance in reducing mortality (Akdam & Alp, 2015). Our results showed that the intervention helped our participants learn how to treat crush syndrome. More studies are needed on this subject.

Hyperkalemia is a common and fatal complication of crush syndrome (Sever, 2021). Therefore, even when the victim is under the rubble, the nurse should start the treatment to lower his/her blood potassium level at the doctor's request (Aydın & Altuntaş, 2019). The most striking finding of all laboratory data after the Izmit earthquake was that the serum potassium value was higher than 6.5 mEq/L in 91 cases (22.7%) at admission. Thirty cases had serum potassium above 7 mEq/L. Thirteen cases had serum potassium above 7.6 mEq/L. Sixteen cases had serum potassium above 8.1 mEq/L. Many patients died from hyperkalemia in the first hours or even in the first minutes of admission (Sever et al., 2021). Therefore, such patients must receive IV fluid replacement therapy as soon as possible. This treatment prevents the development of acute renal failure and positively affects the prognosis. Nursing care is also very important for these patients (Aygin & Atasoy, 2008). Disaster nurses should know enough about hyperkalemia and intervene in a timely and correct manner to reduce mortality. In the pretest, more than half the participants marked Statement 20 as "true" (69.8%). However, almost all participants marked it as "true" in the posttest (97.7%).

Acute Kidney Failure (AKF) is another complication of crush syndrome. However, not every patient with crush syndrome develops AKF. Only one-third of all cases develop AKF. Therefore, morbidity and mortality can reach 40% (Sever et al., 2021). According to statistics, eight out of ten people die immediately in collapsed buildings after an earthquake. One in five earthquake survivors develops crush syndrome. One-third of people with crush syndrome develop impaired kidney function (Aydın & Altuntaş, 2019). After the Izmit earthquake, 639 patients developed acute renal problems due to crush syndrome, and 477 of them

required dialysis treatment (Aygin & Atasoy, 2008; Sever et al., 2001). Therefore, the Izmit earthquake is the most serious "kidney disaster" documented to date (Sever et al., 2001). In addition, the "epidemic" of kidney failure that emerged after the Izmit earthquake is the biggest nephrological disaster documented throughout the history of medicine. The Izmit earthquake made authorities recognize that Turkey is a "country of earthquakes" (Sever et al., 2021). Disaster nursing, emergencies, crush syndrome, and nursing care is more important in Turkey because it is a country of earthquakes. Acute Kidney Failure is a complication of crush syndrome that can have fatal consequences or lead to serious sequelae. In this regard, nurses and nursing students should have sufficient knowledge and skills. In the pretest, most participants marked Statement 2 as "true" (90.7%). In the posttest, all participants marked it as "true". The results indicate that nursing students know enough about AKF and its consequences.

CONCLUSION AND RECOMMENDATIONS

The frequency and severity of natural and artificial disasters are a global concern. Therefore, it is important to equip health professionals with sufficient knowledge and skills. Nursing students learn about crush syndrome in the "Disaster Management and Nursing" and "Internal Medicine Nursing" courses. However, the AMAWCS is an effective intervention that helps nursing students learn about crush syndrome and its complications and treatment. Our results show that interventions allow nursing students to acquire the necessary knowledge about crush syndrome and implement the right, adequate, and high-quality nursing care. However, researchers should do more research. Another important issue is that universities should include disaster nursing in their curricula as separate courses. Moreover, those courses should address crush syndrome and nursing care adequately. In addition, laws and regulations should specify the job description of disaster nurses and define the roles and responsibilities of disaster nurses.

Performing algorithmic studies in disaster nursing or similar courses can contribute to increase the level of knowledge. It is important to design algorithms for reinforcing issues that require urgent intervention, such as disaster nursing.

Ethics Committee Approval: Prior to the start of the study, ethical approval was received from the research ethics committee of the University of XXXXXXX (27.10.2021-E.161368). All patients provided informed consent for each insertion in accordance with the principles of the Declaration of Helsinki.

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