NORTHERN JOURNAL of HEALTH SCIENCES

Research Article

Determination of Diabetes Knowledge Level in Intensive Care Unit Nurses*

Neslihan Koyuncu[1], Elif Ünsal Avdal[2], Mustafa Agah Tekindal[3]

[1]Izmir Health Sciences University, Dr. Suat Seren Chest Diseases and Thoracic Surgery Training and Research Hospital, Izmir, Türkiye.
[2]Izmir Kâtip Celebi University, Faculty of Health Sciences Department of Internal Medicine Nursing, Izmir, Türkiye.
[3]Izmir Kâtip Celebi University, Faculty of Medicine Department of Biostatistics, Izmir, Türkiye.

Cite this article as: Koyuncu, N., Ünsal Avdal, E., Tekindal, M.A. (2025). Determination of diabetes knowledge level in intensive care unit nurses. *Northern Journal of Health Sciences,* 1(1),1-14.

Corresponding Author:
Neslihan Koyuncu
E-mail:
nesli788200@gmail.com

ORCID IDs of the authors:
N.K. 0000-0002-1991-0747
E.Ü.A. 0000-0001-6888-0882
M.A.T., 0000-0002-4060-7048

Received: September 17, 2024
Revision Requested: October 12, 2024
Accepted: November 5, 2024
Publication Date: January 24, 2025

*This research is derived from Neslihan Koyuncu's Master's thesis.

Abstract

Objective: The knowledge level of intensive care nurses, who are primarily responsible for follow-up and treatment in intensive care units, about general diabetes and insulin applications is significant for good glucose regulation. This study aimed to examine the knowledge levels of intensive care nurses about diabetes and the factors affecting them.

Method: The descriptive study was conducted with 328 (n=328) nurses between February 2021 and June 2021. Demographic questionnaires and the Diabetes Knowledge Test developed by the Michigan Diabetes Research and Education Center were administered after obtaining the voluntary consent of the participants. The data obtained were evaluated by applying Kruskal Wallis, Mann Withney U and Wilcoxon W tests in SPSS 25.0 program, and statistical significance was defined as $p < 0.05$.

Results: When the answers given to the questionnaires according to the demographic data of the nurses were compared, it was found that the most important factors affecting the level of diabetes knowledge were the level of education and the number of relatives with diabetes. In our study, the level of diabetes knowledge in intensive care nurses was 74.8%. However, no statistically significant difference was found between nurses with and without intensive care certificates and nurses with and without previous diabetes education.

Conclusion: In order to evaluate intensive care nurses, it is recommended that the content of diabetes education given in the in-service and intensive care certificate programs and the survey questions be reviewed, planned and implemented for intensive care services.

Keywords: Diabetes, Intensive Care, Knowledge, Nurse.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic syndrome characterized by hyperglycemia. Defects in insulin metabolism lead to hyperglycemia and prolonged exposure to hyperglycemia can cause damage to tissues and organs (Abdullah et al., 2001). DM is the most common endocrine disorder in the general population and in intensive care unit patients (Durmaz, 2009). Today, diabetes is an increasingly important health problem all over the world due to its frequency and complications, and 9.3% of adults aged 20-79, approximately 463 million people, live with diabetes (Alotaibi et al., 2016; American Diabetes Association Professional Practice Committee, 2024; ElSayed et al., 2024). One point one million children and adolescents under the age of twenty are also living with Type 1 diabetes (American Diabetes Association Professional Practice Committee, 2024; ElSayed et al., 2024). The International Diabetes Federation (IDF) estimates that there will be 578 million adults with diabetes by 2030 and 700 million by 2045 (Anderson et al., 2000). The mortality and morbidity rates of diabetes are gradually increasing in the world and are frequently encountered in intensive care units due to its increasing prevalence and leading to complications in cases where monitoring and treatment are uncontrolled (Aydoğan, 2005; The NICE-SUGAR, 2015). In hospitalized individuals with DM, well-controlled blood glucose levels are very important in improving clinical symptoms, preventing and treating infections, reducing cardiac, cerebral and respiratory disorders and especially in ensuring wound healing. Therefore, the importance of the care and monitoring of individuals with DM in preoperative care units, postoperative intensive care units and general intensive care units is increasing day by day (Anderson et al., 2000; Bansal et al., 2018; Drass et al., 1989). It is extremely important that intensive care nurses, who closely observe intensive care patients, continuously follow the changes and developments in patients, identify problems in the early period and spend a long time with patients, can take an active and effective role in the blood glucose regulation of patients (Canbolat et al., 2019). Nurses have the responsibility to make decisions on issues such as chronic disease management, patient care and improving patient care from the first encounter with the patient in intensive care units (Canbolat & Kapucu, 2021). In order to ensure optimal blood glucose regulation in intensive care patients, in addition to appropriate treatment, follow-up of the individual with diabetes, correct administration of diabetes medications, complications and nutrition should be monitored. Therefore, the knowledge level of intensive care nurses regarding general diabetes and insulin applications has become more important with the increasing prevalence of diabetes (Chianca et al., 2012). Although the available evidence is limited, it is thought that appropriate blood glucose control may help prevent exacerbation of Covid-19 in patients with diabetes. Under the current circumstances, where there is no definitive cure for the disease, it is noted that the role of blood glucose control in recovery is important (Collins et al., 2011). Approximately 30-40% of patients admitted with Covid-19 infection have hyperglycemia and/or diabetes. Studies are being conducted on standard clinical practices and protocols and the effectiveness of devices to ensure that glucose control in intensive care is safe and effective and does not create a workload for nurses (Corrêa et al., 2012; Coursin et al., 2002). Appropriately trained health care teams can improve glycemic control and outcomes and shorten hospital stays (Arda

Dağdelen, 2012; Daly et al., 2014; Evans et al., 2021). Studies have shown that hospital readmission rates and costs can be reduced in patients who receive inpatient treatment by a team that can manage diabetes (Draznin et al., 2013; El-Deirawi & Zuraikat, 2001; Ergan et al., 2018). In a meta-analysis of studies in which education and standardized practices were organized to improve glucose control in the hospital, there was a decrease in the mean of blood glucose levels, no increase in hypoglycemia, and an increase in the time patients spent within the target range of blood glucose values (Fitzgerald et al., 2016). Glucose regulation is one of the important factors determining mortality and morbidity in patients with diabetes followed up in intensive care units. Therefore, in hospitalized intensive care patients, especially in intensive care patients who are frequently encountered with hyperglycemia and who need critical and continuous care, it is important to follow up and treat diabetes by nurses who are primarily responsible for patient follow-up.

The aim of this study was to determine the knowledge levels of intensive care nurses about diabetes and to examine the factors affecting their knowledge levels by accepting nurses working in intensive care units and nurses with previous experience of working in intensive care units as a sample.

METHOD

This descriptive study was conducted between February 2021 and June 2021 at Health Sciences University Tepecik Training and Research Hospital located in Konak district of Izmir province, after obtaining written permission from Izmir Health Sciences University Dr. Suat Seren Chest Diseases and Thoracic Surgery Training and Research Hospital and obtaining the voluntary consent of the nurses included in the study. Diabetes treatment of patients in secondary and tertiary intensive care units in these hospitals is planned by intensive care physicians, with internal medicine or endocrine consultation when necessary. Activities such as implementation of treatment, blood glucose monitoring, planning and monitoring of nutrition, diabetic medication management (cold chain, etc.), patient monitoring, follow-up of additional diseases, diabetic wound dressing are also carried out by intensive care nurses. A total of 1296 nurses work in these two hospitals and 328 nurses were reached. The reason for this was that our inclusion criteria required participants to be currently working in any intensive care unit or to have worked in intensive care for at least one year previously. Our exclusion criteria were working in intensive care unit for less than one year and not having worked in intensive care unit before. From a total of 366 nurses working at Dr. Suat Seren Chest Diseases and Thoracic Surgery Training and Research Hospital, we reached all 72 nurses currently working in intensive care units and 60 nurses currently working in different units who had previously worked in intensive care units. Out of a total of 930 nurses working in Tepecik Training and Research Hospital, 220 intensive care nurses working in intensive care units were tried to be reached and a total of 196 nurses voluntarily completed the questionnaire. According to the power analysis performed at the planning stage of the study, the sample size was determined to reach at least 250 nurses (n ≥250).

Data Collection Tools

Demographic Data Form and Diabetes Knowledge Test (DKT) were used as data collection tools.

Demographic Data Form: The demographic data form prepared by the researchers consisted of

16 questions, and open-ended answers were left for those who answered 'yes' to three questions. In this form, descriptive characteristics of the nurses are asked (age, gender, marital status, educational status, working time in the profession, professional status, the unit and duration of employment, the duration of employment in intensive care, whether or not they have an intensive care certificate, whether or not they have received diabetes education in the certificate program, evaluation of general diabetes knowledge, whether or not they have received diabetes education before, how often they encounter diabetics, whether they have diabetes in their family, and chronic disease status).

Diabetes Knowledge Test (DKT): The Diabetes Knowledge Test consists of 23 knowledge test items developed by the Michigan Diabetes Research Training Center (MDRC). The first 14 questions cover diet, metabolic testing, diabetes complications and exercise. The last nine questions are about insulin and insulin administration. The test takes approximately 15 minutes to complete. Each question has only one correct answer. Correct answers are awarded one point and incorrect and blank answers are awarded zero points. The scores obtained for each nurse were converted into percentages (Fitzgerald et al., 1998; Futatsugi et al., 2020). Permission to use the DKT was obtained from MDRC via e-mail and supported by the number P30DK020572.

Statistical Analysis

The data obtained were evaluated by applying Kruskal Wallis, Mann Withney U, Wilcoxon W tests by an expert in the field of biostatistics in SPSS 25.0 package program. Statistical significance was defined as $p<0.05$.

RESULTS

Our study was conducted with a total of 328 nurses, 206 female (79.2%) and 68 male (20.7%). The scores obtained by female nurses from the first 14 questions of the questionnaire (including diet, metabolic tests, diabetes complications and exercise) and the last nine questions (including insulin and insulin applications), that is, the level of diabetes knowledge, were higher than those obtained by male nurses. The difference in scores was found to be significant ($p<0.05$), and it was thought that this difference was due to the fact that the number of female nurses working in the general hospital environment and participating in the study was higher than the number of male nurses (Table 1). Of the nurses who participated in the study, 23 were high school graduates, 36 were associate degree graduates, 220 were bachelor's degree graduates, 44 were master's degree graduates and five were PhD graduates, and the number of bachelor's degree graduates constituted the highest level of knowledge was found in master's degree graduates with 44 people. The scores of high school, associate degree, bachelor's degree and master's degree graduates in all questions of the questionnaire were significantly and quite different ($p<0.05$) (Table 2).

The higher the degree of graduation, the higher the scores obtained and therefore the higher the level of diabetes knowledge. When we examined whether the nurses received diabetes education according to their educational status, 52.2% of high school graduates, 50% of associate's and bachelor's degree graduates, 38.6% of master's degree graduates and all doctoral graduates stated that they had received diabetes education before. In total, 49.4% of the participants stated that they had received DM education and 50.6% stated that they had not.

Table 1. Comparison of Diabetes knowledge level of nurses participating in the study according to gender (n=328)

Diabetes Knowledge Test	Female	Male	Test Statistic*	p
Metabolic Tests/Complications Exercise questions	**Mean±Std. Deviation**		-4,184	**<0,01**
	9,65±2,06	8,54±2,27		
	Median (Min-Max)			
	10 (0-13)	8(2-13)		
Insulin Applications Questions about the questions	**Mean± Std. Deviation**		-2,634	**0,008**
	7,06±1,7	6,33±2,09		
	Median (Min-Max)			
	7 (0-9)	7(1-9)		
Total Score	**Mean± Std. Deviation**		-3,648	**<0,01**
	16,7±3,3	16,33±3,5		
	Median (Min-Max)			
	17 (0-22)	17(0-22)		

*Mann Whitney-U/Wilcoxon W

Our inclusion criteria were that the nurses should be working in intensive care or have worked in intensive care for at least one year before. In this context, when we compared the scores of the nurses who participated in the study according to the units they were currently working in, it was seen that there was no significant difference in terms of diabetes knowledge level (p>0.05) (Table 3). One of the nurses had been working in their current units for 19 years and 76 of them had been working in their current units for one year, and when the working time in these clinics was evaluated, no significant difference was found in terms of diabetes knowledge level (p>0.05). Of the nurses who participated in our study, 114 (34.7%) had been working in intensive care for 1-5 years. No significant difference was found when the duration of employment in intensive care unit was compared with the level of diabetes knowledge (p>0.05) (Table 4).

Table 2. Comparison of Diabetes knowledge level according to the education level of the nurses participating in the study (n=328)

Level of Education	High School	Associate Degree	Bachelor's Degree	Master Degree	Doctoral Degree	Test Statistic*	p
Metabolic Tests Complication/ Exercise questions	**Mean±Std. Deviation**					21,665	**<0,01**
	7,26±3,1	8,88±3,0	9,59±1,7	10,11±1,9	9,60±0,8		
	Median (Min-Max)						
	7(0-12)	9,5(2-13)	10(4-13)	11(2-13)	10(8-10)		
Insulin Applications Questions about the questions	**Mean±Std. Deviation**					12,563	**0,014**
	5,39±2,5	6,44±2,2	7,13±1,5	6,93±1,8	7,60±0,8		
	Median (Min-Max)						
	5(0-9)	7(1-9)	7(1-9)	7(1-9)	8(6-8)		
Total Score	**Mean± Std. Deviation**						**<0,01**
	12,65±5,4	15,33±4,9	16,72±2,8	17,04±3,4	17,20±1,7		
	Median (Min-Max)						
	14(0-20)	16,5(3-22)	17(5-22)	18(3-21)	18(14-18)	17,966	

*Kruskal Wallis H

Table 3. Comparison of Diabetes knowledge levels of the nurses participating in the study according to the units they work (n=328)

Units	MetabolicTests Complication/ Exercise questions	Insulin Applications Questions about the questions	Total Score
	Mean±Std Deviation Median(Min-Max)		
Surgical wards	8,67±3,3 10(0-12)	6,64±2,8 8(0-9)	15,32±5,9 17,5(0-21)
Internal services	10,00±2,0 10(5-13)	7,48±1,2 7(4-9)	17,48±2,7 17(9-21)
Emergency Services	9,52±1,6 10(6-13)	6,72±1,5 7(3-9)	16,24±2,7 17(11-22)
ICU	9,38±2,0 10(2-13)	6,90±1,7 7(1-9)	16,29±3,3 17(3-22)
Polyclinic	8,75±3,0 10(4-12)	6,00±2,2 7(2-8)	14,75±5,1 17(6-19)
Operating Room	9,21±1,8 9,5(4-11)	6,42±2,0 6,5(1-9)	15,64±3,5 16(5-20)
Palliative care	10,12±1,1 10(9-12)	7,87±1,1 8(6-9)	18,00±2,0 18(15-21)
Education Unit	11,50±1,0 11(11-13)	6,50±1,7 7(4-8)	18,00±2,1 18,5(15-20)
Matron	9,50±0,7 9,5(9-10)	8,50±0,7 8,5(8-9)	18,00±0,0 18(18-18)
Test Statistic*	11,168	14,384	11,424
P	0,345	0,156	0,325

*Kruskal Wallis H

Similar results were obtained when the duration of working in intensive care unit and diabetes knowledge levels of nurses who had previously worked in intensive care units were compared. It is thought that the fact that intensive care units are mostly composed of new graduates and young individuals and that nurses cannot work in these units for many years due to the high workload in intensive care units and transfer to other units may be effective in the lack of difference. One of the most important hypotheses of our study was whether there was a difference between nurses with and without an intensive care certificate in terms of diabetes knowledge level. Of the nurses who participated in our study, 111 (33.8%) had an intensive care certificate and 217 (66.1%) did not. In our study, no significant difference was found between nurses with and without a certificate in terms of diabetes knowledge level ($p > 0.05$). When we examined the status of diabetes education in the certificate program of nurses with a certificate, it was found that 64% received diabetes education in the certificate program and 45.9% did not receive diabetes education in the certificate program. When we compared the results of the questionnaire according to the nurses' previous DM education, 49.3% of the nurses stated that they had received diabetes education before and 50.6% stated that they had not received diabetes education before. When we compared the scores of the nurses according to their DM training status, no statistically significant difference was found ($p>0.05$). Among the nurses who received

diabetes education, 76 of them received DM education once and five of them received DM education many times, but no significant difference was found between the number of education and diabetes knowledge level (p>0.05).

Table 4. Comparison of Diabetes knowledge levels of the nurses participating in the study according to the duration of working in Intensive Care Unit (n=328)

Intensive Care Unit Working Period	Metabolic Tests Complication/ Exercise questions	Insulin Applications Questions about the questions	Total Score
	Mean±Std. Deviation Median (Min-Max)		
1-5 year	9,32±1,9 9(2-13)	6,92±1,7 7(1-9)	16,25±3,1 17(3-22)
5-10 year	9,25±2,2 9(2-13)	6,67±2,0 7,5(1-9)	15,93±4,0 17(3-21)
10-20 year	9,66±1,6 10(4-12)	7,29±1,1 7(5-9)	16,96±2,2 17(11-20)
20 and above	1 kişi 9,00	1 kişi 6,00	1 kişi 15,00
I'm not working right now	9,54±2,3 10(0-13)	6,94±1,9 7(0-9)	16,49±3,9 17(0-22)
Test Statistic*	3,673	1,694	3,296
p	0,452	0,791	0,509

*Kruskal Wallis H

When we examined the status of receiving diabetes education in the certificate program of nurses with a certificate, it was found that 64% received diabetes education in the certificate program and 45.9% did not receive diabetes education in the certificate program. We asked the nurses to answer the frequency of encountering patients with diabetes. Thirty-nine point six percent of the nurses stated that they met with patients with diabetes every day, 34.1% met with them two to three times a week, 10.6% met with them once or twice a month and 15.5% rarely met with them. When we compared the scores of nurses according to the frequency of encountering patients with diabetes, no significant difference was found (p>0.05).

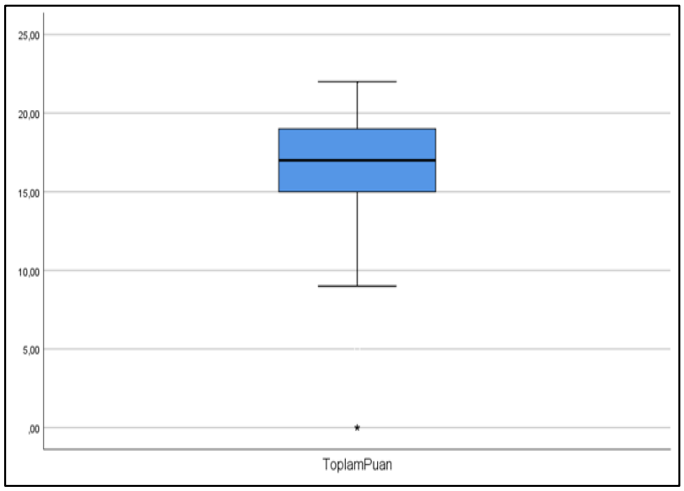
When we analyzed the nurses according to having a relative with diabetes, 42% had a relative with diabetes and 57.6% did not have a relative with diabetes. When the scores obtained from the questionnaire by nurses with and without relatives with diabetes were compared, the knowledge levels of those with relatives with diabetes in the first 14 questions were found to be significantly higher than those without (p< 0.05). There was no statistical difference (p>0.05) between the scores of the nurses who had a relative with diabetes and the scores of the nurses who did not have a relative with diabetes. In our study, when we examined

how many relatives with diabetes the nurses who had relatives with diabetes had; it was seen that 79 of them had one relative with diabetes and 47 of them had two relatives with diabetes. It was observed that the level of diabetes knowledge increased as the number of relatives with diabetes increased, and those with four or more relatives with diabetes had higher levels of diabetes knowledge ($p< 0.05$).

When the chronic disease status of the nurses was analyzed, it was found that 74 nurses (22.5%) had chronic disease and 253 nurses (77.1%) did not have chronic disease. When the questionnaire scores were evaluated according to chronic disease status, no statistically significant difference was found ($p>0.05$). When the participant nurses were evaluated according to the type of chronic disease, it was concluded that most of the nurses had thyroid disease (24.3%), 16.2% had diabetes and 76.8% did not have chronic diseases. When chronic disease status and questionnaire scores were analyzed, no statistically significant difference was found, and the presence of diabetes did not make a difference ($p>0.05$).

Most of the nurses who participated in our study (n=217) did not have an intensive care certificate. The reason for this is thought to be that nurses working in intensive care units have less time in intensive care units and that certificate programs and in-service diabetes trainings could not be organized due to the Covid-19 pandemic that has been going on for two years. It was also thought that there may not have been enough time to answer the survey questions effectively due to reasons such as the workload of the nurses, the fact that the hospitals where the study was conducted were very busy hospitals due to their location, being in the pandemic period.

As a result, the nurses who participated in our survey received a median score of 16 points from the questionnaire. Diabetes knowledge level was high with 74.8%, but it was not statistically significant (Graph 1).



Graph 1: Knowledge level of nurses according to the answers given to the survey questions (n=328)

DISCUSSION

Diabetes is one of the most common endocrine disorders in the general population and in intensive care unit patients. In hospitalized individuals with DM; well-controlled blood glucose levels are very important in improving clinical symptoms, preventing or treating infections, treating cardiac, cerebral, respiratory disorders and especially in ensuring wound healing. Therefore, the importance of the care and monitoring of individuals with DM in preoperative care units, postoperative intensive care units and general intensive care units is increasing day by day (American Diabetes Association, 2021; Modic et al., 2014; Olsen et al., 2012; Ostling et al., 2017).

It is extremely important that intensive care nurses, who closely observe intensive care patients, continuously monitor changes and developments in patients, recognize problems at an early stage and spend a long time with patients, can take an active and effective role in the glycemic follow-up of patients. Nurses have the responsibility to make decisions on issues such as chronic disease management, patient care and improving patient care from the first encounter with the patient in intensive care units. The overall management of all types of diabetes is related to multiple factors such as medication, diet and nutrition, blood glucose control, regular physical activity, and the presence/screening for long-term complications. In this decision-making role model, nurses should have the necessary diabetes knowledge to provide effective treatment and care (American Diabetes Association Professional Practice Committee, 2024; Canbolat & Kapucu, 2021; Modic et al., 2014).

Nursing professionals receive diabetes-related trainings in undergraduate education, after which they can obtain information about diabetes by receiving diabetes education in various certificate programs or in the form of in-service training in the institutions where they work. In some studies, it has been reported that nurses and doctors are the most effective people in increasing the knowledge level of patients with diabetes, and that nurses have a great effect on reducing the HbA1c level of patients and their compliance with the diet (Adam et al., 2003; Modic et al., 2014).

Different tests have been developed to determine the level of knowledge about diabetes and these tests have been used in different studies (Fitzgerald et al., 1998; Gupta & Hudson, 2017; Hall & Davies, 2008; Saeedi et al., 2020). In Turkey, no scales related to diabetes knowledge level were found in the diabetes scales search in the Turkish Measurement Tools Directory (TOAD) (Magliano et al., 2021). In our literature review, some studies and articles were found in which the diabetes knowledge test we used in our study was used, and it was seen that this test was generally used in our country to examine the level of diabetes knowledge in patients, clinical nurses and student groups (İdiz et al, 2020; Khalaila et al., 2011; Kim & Oh, 2003; Leggett-Frazier et al., 1994; Livingston & Dunning, 2010; Modic et al., 2009). There are no studies in Turkey in which diabetes knowledge level test was used to evaluate the diabetes knowledge level of intensive care nurses. Therefore, our study constitutes a first.

After the Diabetes Knowledge Level Test was validated and published in 1998, it was revised and re-published by Fitzgerald et al. in 2016 (Nash, 2009). In most of the studies conducted with patients with diabetes, factors such as age, gender, education level, duration of diabetes treatment and depression levels of patients were found to be effective on diabetes knowledge level (Olsen et al., 2012). In studies

conducted with nurses, the frequency of encountering patients with diabetes in the units where nurses work, in-service trainings about diabetes and access to educational resources were found to be important factors (Ostling et al., 2017). In our study, the level of diabetes knowledge of nurses did not create a significant difference according to the units they worked in and the status of receiving diabetes education. Oyetunde et al. (2014) found that the mean scores of intensive care nurses were significantly higher than those of internal medicine, surgery and gynecology clinics. In another study, it was stated that working time was found to be a factor affecting the knowledge level of nurses, and it was reported that diabetes knowledge was lower in those with less working time (Patterson et al., 2019).

While the development process of nursing continued, certified training programs for specialization began to be organized and in this context, intensive care certificate programs were established for intensive care nurses. The aim of the Intensive Care Nursing Certified Training Program in our country is to train intensive care nurses who provide physical, psychological and social empowerment of the individual with preventive, developmental and rehabilitative interventions, establish therapeutic communication with patients and their families, adapt to developments in health science and technology, new treatment and care methods, have the competence to meet emergency, critical and complex patient care needs, and have advanced problem-solving skills. In this training program, which lasts an average of four to five weeks, both theoretical and practical trainings are given, and at the end of the training period, a written exam is held and the successful participants are given certificates approved by the Ministry of Health. In our study, we investigated the diabetes education status of intensive care nurses, whether they had an intensive care certificate and their level of diabetes knowledge according to their certificate status. One hundred and eleven of the nurses participating in our study had an intensive care certificate, while 217 did not have a certificate. When we examined the status of receiving diabetes education in the certificate program of nurses with a certificate, it was found that 64% received diabetes education in the certificate program and 45.9% did not receive diabetes education in the certificate program. There was no significant difference between nurses with a certificate and nurses without a certificate in terms of diabetes knowledge level ($p>0.05$). Although in different countries, many studies have found low rates of individual participation in diabetes-related trainings among nurses. The age of nurses, excessive workload and working conditions have been identified as barriers that affect nurses' acquisition of diabetes knowledge (Ostling et al., 2017). In a literature review conducted by Alotaibi et al. (2016) from 2004 to 2014 on the level of diabetes knowledge of nurses, studies investigating the knowledge level of nurses using the Diabetes Basic Knowledge Tool (DBKT) and the Diabetes Self-Report Tool (DSRT) were examined and it was concluded that 34% of nurses did not have sufficient knowledge about OADs (Scheiderich et al., 1983). Twelve articles from the USA, UK and Jordan were reviewed and in ten studies, nurses' knowledge of insulin therapy, including injection administration time and storage conditions, was found to be low (48%). It was concluded that 34% of nurses did not know the correct storage conditions of insulin (Oyetunde & Famakinwa, 2014; Patterson et al., 2019; Scheiderich et al., 1983). In a study conducted in the United Kingdom, it was found that 72% of pediatric nurses working with specialist doctors had a low level of knowledge about insulin administration time

and storage (Thomas, 2004). Three studies conducted in the UK, Nigeria and Hong Kong revealed that nurses have insufficient knowledge about general diabetes knowledge, foot care and wound care in diabetes (Shiu & Wong, 2011; Soysal, 2019; Sucu et al., 2012). Inadequate knowledge about diabetes complications can be serious for patients. Complications such as lower extremity amputations, cardiovascular disease, nephropathy, retinopathy, hypoglycemia, ketoacidosis cause serious consequences in these patients. Studies conducted in different countries have revealed that nurses have insufficient knowledge about diabetes complications (Soysal, 2019; Toraman, 2019). In the studies conducted by Modic et al. (2009) and Modic et al. (2014), it was concluded that experienced cardiovascular nurses in intensive care centers had less knowledge about insulin therapy. A study conducted in the UK concluded that more than 54% of pediatric nurses were not aware of the possible side effects of repeated insulin injections (Thomas, 2004). The common conclusion of these studies was that nurses in many countries lack knowledge in at least some aspects of insulin therapy and that this lack of knowledge can significantly affect their ability to effectively manage diabetes.

In the literature review conducted by Alotaibi et al. (2016), nine studies were identified in which nurses' knowledge of diabetes pathology and symptoms were evaluated and the level of diabetes knowledge was found to be low in these studies. In a study conducted in the USA (Scheiderich et al., 1983), 26% of acute care nurses did not have knowledge about the genetic aspects of Type 1 diabetes, and in Nigeria, 50.9% of nurses did not know any signs of diabetes or symptoms of diabetes ketoacidosis, and only 12% were able to recognize all symptoms (Valk & McMorrow, 2020). Nutrition is one of the most important content areas of diabetes care. In the literature review conducted by Alotaibi et al. (2016), seven of 12 studies evaluated nurses' knowledge of nutrition in diabetes and reported that the level of knowledge was insufficient. In two studies conducted in Sweden, it was concluded that nurses lacked knowledge about diabetes types (Olsen et al., 2012). In general, research results show that there is a lack of knowledge about the pathology, symptoms and management of diabetes among nurses in many countries. The literature review by Alotaibi et al. (2016) found that barriers to acquiring knowledge about good practices, care and development in diabetes were commonly reported across participants. Alotaibi et al. (2016), who stated that some strategies managed to significantly improve nurses' diabetes knowledge and attitudes, stated that organizing a formal education program every three months with multidisciplinary expert diabetes teams (e.g. doctors, pharmacists, nurses and diabetes educators) and sharing updates about diabetes is beneficial for nurses and their patients. In our study, as in the study of Oyetunde et al. (2014), it was observed that the scores of those with relatives with diabetes were higher than those without relatives with diabetes. As the number of relatives with diabetes increased, the level of knowledge increased significantly ($p<0.05$). The fact that there was no difference between professional experience, i.e. working time, and diabetes knowledge level in our study is supported by the study of Oyetunde et al. (2014).

CONCLUSION

In our questionnaire in which we evaluated the level of diabetes knowledge in intensive care nurses in many aspects, although the level of knowledge was above average, working in intensive care and having an intensive care

certificate did not statistically make a difference in terms of the level of knowledge. This situation is thought to be due to the fact that the hospitals where the study was conducted were very busy hospitals due to their location, the workload of the intensive care nurses participating in our study, the fact that they could not find enough time to answer the survey questions effectively due to reasons such as being in the pandemic period, and the lack of distinctive questions about diabetes practices in intensive care within the survey questions.

The most important factor affecting the level of diabetes knowledge in intensive care nurses is education. In order to provide standard care for patients with diabetes in intensive care units, it is recommended that in-service training on diabetes practices in intensive care units be provided, trainings be increased and these trainings be provided by diabetes education nurses who are experts in their field, protocols for the care of patients with diabetes in intensive care units of each institution be established and these protocols be implemented by nurses working in intensive care units, the content of diabetes education in intensive care certificate programs be reviewed and provided in accordance with intensive care standards. In order to evaluate the level of diabetes knowledge of intensive care nurses, it is recommended that the current questionnaire be developed for intensive care practices.

Limitations of the Study

The data of this study can be generalized only to the institutions where the study was conducted, since the study was conducted with nurses who worked or had worked in intensive care units in two training and research hospitals located in Konak district of Izmir province between the dates of the study and whose permissions were obtained, who met the inclusion criteria and volunteered.

Declaration of Interests: The authors have no conflict of interest to declare.

Financial Support: No financial support was received for this research.

Ethical Approval: This study was approved by the Izmir Kâtip Çelebi University Non-Interventional Clinical Research Ethics Committee (Date: 18.02.2021) and (Decision no: 0036) and was conducted in accordance with the ethical rules in the Declaration of Helsinki**.**

References

Abdullah, L., Margolis, S., & Townsend, T. (2001). Primary health care patients' knowledge about diabetes in the United Arab Emirates. *Eastern Mediterranean Health Journal = La Revue De Sante De La Mediterranee Orientale = Al-Majallah Al-Sihhiyah Li-Sharq Al-Mutawassit*, *7*(4–5), 662–670.

Adam, K. D., Wendel, C. S., Solvas, P. A., Hoffman, R. M., Duckworth, W. C., Murata, G. H., Shah, J. H., & Bokhari, S. U. (2003). Factors affecting diabetes knowledge in Type 2 diabetic veterans. *Diabetologia*, *46*(8), 1170–1178.

Alotaibi, A., Al-Ganmi, A., Gholizadeh, L., & Perry, L. (2016). Diabetes knowledge of nurses in different countries: An integrative review. *Nurse Education Today*, *39*, 32–49.

American Diabetes Association. (2021). 1. Improving Care and Promoting Health in Populations: Standards of Medical Care in Diabetes—2021. *Diabetes Care*, *44*(Supplement 1), S7–S14.

American Diabetes Association Professional Practice Committee, ElSayed, N. A., Aleppo, G., Bannuru, R. R., Bruemmer, D., Collins, B. S., Ekhlaspour, L., Galindo, R. J., Hilliard, M. E., Johnson, E. L., Khunti, K., Lingvay, I., Matfin, G., McCoy, R. G., Perry, M. L., Pilla, S. J., Polsky, S., Prahalad, P., Pratley, R. E., … Gabbay, R. A. (2024). Diabetes Care in the Hospital: Standards of Care in Diabetes—2024. *Diabetes Care*, *47*(Supplement_1), S295–S306.

Anderson, R. M., Funnell, M. M., Fitzgerald, J. T., & Marrero, D. G. (2000). The Diabetes Empowerment Scale: A measure of psychosocial self-efficacy. *Diabetes Care*, *23*(6), 739–743. https://doi.org/10.2337/diacare.23.6.739

Arda Dağdelen, Z. (2012). *Aydın merkezde diyabet bilinci: Diyabetle ilgili bilgi düzeyi ve ilişkili faktörler*, Tıpta Uzmanlık Tezi, Adnan Menderes Üniversitesi.

Aydoğan, A. (2005). *Hemşirelerin Diyabet İle İlgili Bilgi Düzeylerinin Tespiti,* Yüksek Lisans Tezi, Afyon Kocatepe Üniversitesi.

Bansal, V., Mottalib, A., Pawar, T. K., Abbasakoor, N., Chuang, E., Chaudhry, A., Sakr, M., Gabbay, R. A., & Hamdy, O. (2018). Inpatient diabetes management by specialized diabetes team versus primary service team in non-critical care units: Impact on 30-day readmission rate and hospital cost. *BMJ Open Diabetes Research & Care*, *6*(1), e000460.

Canbolat, Ö., & Kapucu, S. (2021). The Effect of Computer-Assisted Glycemic Monitoring Protocol on Workload of Intensive Care Nurses. *Hacettepe Üniversitesi Hemşirelik Fakültesi Dergisi*, *8*(3), 293–298.

Canbolat, O., Kapucu, S., & Kilickaya, O. (2019). Comparison of Routine and Computer-Guided Glucose Management for Glycemic Control in Critically Ill Patients. *Critical Care Nurse*, *39*(4), 20–27.

Chianca, T. C. M., Lima, A. P. S., & Salgado, P. D. O. (2012). Diagnósticos de enfermagem identificados em pacientes internados em Unidade de Terapia Intensiva Adulto. *Revista Da Escola de Enfermagem Da USP*, *46*(5), 1102–1108.

Collins, G. S., Mughal, S., Barnett, A. H., Fitzgerald, J., & Lloyd, C. E. (2011). Modification and validation of the Revised Diabetes Knowledge Scale. *Diabetic Medicine*, *28*(3), 306–310.

Corrêa, T. D., Almeida, F. P. D., Cavalcanti, A. B., Pereira, A. J., & Silva, E. (2012). Avaliação da percepção de enfermeiros sobre três protocolos para controle glicêmico em pacientes críticos. *Einstein (São Paulo)*, *10*(3), 347–353.

Coursin, D. B., Coursin, D. B., & Unger, B. (2002). Endocrine complications in intensive care unit patients. *Seminars in Anesthesia, Perioperative Medicine and Pain*, *21*(1), 59–74.

Daly, B., Arroll, B., Sheridan, N., Kenealy, T., & Scragg, R. (2014). Diabetes knowledge of nurses providing community care for diabetes patients in Auckland, New Zealand. *Primary Care Diabetes*, *8*(3), 215–223.

Drass, J. A., Muir-Nash, J., Boykin, P. C., Turek, J. M., & Baker, K. L. (1989). Perceived and Actual Level of Knowledge of Diabetes Mellitus Among Nurses. *Diabetes Care*, *12*(5), 351–356.

Draznin, B., Gilden, J., Golden, S. H., Inzucchi, S. E., & for the PRIDE investigators. (2013). Pathways to Quality Inpatient Management of Hyperglycemia and Diabetes: A Call to Action. *Diabetes Care*, *36*(7), 1807–1814.

El-Deirawi, K. M., & Zuraikat, N. (2001). Registered nurses' actual and perceived knowledge of diabetes mellitus. *Journal of Vascular Nursing*, *19*(3), 95–100.

Ergan, M., Başkurt, F., & Başkurt, Z. (2018). *Fizyoterapi Öğrencilerinin Diyabet ve Risk Faktörleri Bilgi Düzeylerinin Belirlenmesi*. *31*, 1–7.

Evans, L., Rhodes, A., Alhazzani, W., Antonelli, M., Coopersmith, C. M., French, C., Machado, F. R., Mcintyre, L., Ostermann, M., Prescott, H. C., Schorr, C., Simpson, S., Wiersinga, W. J., Alshamsi, F., Angus, D. C., Arabi, Y., Azevedo, L., Beale, R., Beilman, G., … Levy, M. (2021). Surviving sepsis campaign: International guidelines for management of sepsis and septic shock 2021. *Intensive Care Medicine*, *47*(11), 1181–1247.

Fitzgerald, J. T., Funnell, M. M., Anderson, R. M., Nwankwo, R., Stansfield, R. B., & Piatt, G. A. (2016). Validation of the Revised Brief Diabetes Knowledge Test (DKT2). *The Diabetes Educator*, *42*(2), 178–187.

Fitzgerald, J. T., Funnell, M. M., Hess, G. E., Barr, P. A., Anderson, R. M., Hiss, R. G., & Davis, W. K. (1998). The Reliability and Validity of a Brief Diabetes Knowledge Test. *Diabetes Care*, *21*(5), 706–710.

Futatsugi, H., Iwabu, M., Okada-Iwabu, M., Okamoto, K., Amano, Y., Morizaki, Y., Kadowaki, T., & Yamauchi, T. (2020). Blood Glucose Control Strategy for Type 2 Diabetes

Patients With COVID-19. *Frontiers in Cardiovascular Medicine*, *7*, 593061.

Gupta, T., & Hudson, M. (2017). Update on Glucose Management Among Noncritically Ill Patients Hospitalized on Medical and Surgical Wards. *Journal of the Endocrine Society*, *1*(4), 247–259.

Hall, A. P., & Davies, M. J. (2008). Diabetic emergencies in acute/critical care. *The Foundation Years*, *4*(6), 230–233.

İdiz, C., Çelik, S., Bağdemir, E., Dişsiz, M., & Satman, İ. (2020). Turkish Adaptation of Michigan Diabetes Research and Training Center's Revised Diabetes Knowledge Test and Determination of Factors Affecting the Knowledge Level of Diabetic Individuals. *The Turkish Journal of Endocrinology and Metabolism*, *24*(1), 38–46.

Khalaila, R., Libersky, E., Catz, D., Pomerantsev, E., Bayya, A., Linton, D. M., & Sviri, S. (2011). Nurse-Led Implementation of a Safe and Effective Intravenous Insulin Protocol in a Medical Intensive Care Unit. *Critical Care Nurse*, *31*(6), 27–35.

Kim, H., & Oh, J. (2003). Adherence to diabetes control recommendations: Impact of nurse telephone calls. *Journal of Advanced Nursing*, *44*(3), 256–261.

Leggett-Frazier, N., Turner, M. S., & Vincent, Paulinea. (1994). Measuring the Diabetes Knowledge of Nurses in Long-Term Care Facilities. *The Diabetes Educator*, *20*(4), 307–310.

Livingston, R., & Dunning, T. (2010). Practice nurses' role and knowledge about diabetes management within rural and remote Australian general practices. *European Diabetes Nursing*, *7*(2), 55–62.

Magliano, D. J., Boyko, E. J., & IDF Diabetes Atlas 10th edition scientific committee. (2021). *IDF Diabetes Atlas* (10th ed.). International Diabetes Federation.

Modic, M. B., Albert, N. M., Nutter, B., Coughlin, R., Murray, T., Spence, J., & Brosovich, D. (2009). Diabetes Teaching Is Not for the Faint of Heart: Are Cardiac Nurses Up to the Challenge? *Journal of Cardiovascular Nursing*, *24*(6), 439–446.

Modic, M. B., Vanderbilt, A., Siedlecki, S. L., Sauvey, R., Kaser, N., & Yager, C. (2014). Diabetes management unawareness: What do bedside nurses know? *Applied Nursing Research*, *27*(3), 157–161.

Nash, M. (2009). Mental health nurses' diabetes care skills – a training needs analysis. *British Journal of Nursing*, *18*(10), 626–630.

Olsen, M., Granath, A., Wharén, P., Blom, T., & Leksell, J. (2012). Perceived knowledge about diabetes among personnel in municipal care: A qualitative focus group interview study. *European Diabetes Nursing*, *9*(2), 52–55.

Ostling, S., Wyckoff, J., Ciarkowski, S. L., Pai, C.-W., Choe, H. M., Bahl, V., & Gianchandani, R. (2017). The relationship between diabetes mellitus and 30-day readmission rates. *Clinical Diabetes and Endocrinology*, *3*,3.

Oyetunde, M. O., & Famakinwa, T. T. (2014). Nurses' knowledge of contents of diabetes patient education in Ondo – state, Nigeria. *Journal of Nursing Education and Practice*, *4*(4), p91.

Patterson, C. C., Karuranga, S., Salpea, P., Saeedi, P., Dahlquist, G., Soltesz, G., & Ogle, G. D. (2019). Worldwide estimates of incidence, prevalence and mortality of type 1 diabetes in children and adolescents: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Research and Clinical Practice*, *157*, 107842.

Saeedi, P., Salpea, P., Karuranga, S., Petersohn, I., Malanda, B., Gregg, E. W., Unwin, N., Wild, S. H., & Williams, R. (2020). Mortality attributable to diabetes in 20–79 years old adults, 2019 estimates: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Research and Clinical Practice*, *162*, 108086.

Scheiderich, S. D., FreiBaum, C. N., & Peterson, L. M. (1983). Registered Nurses' Knowledge About Diabetes Mellitus. *Diabetes Care*, *6*(1), 57–61.

Shiu, A. T., & Wong, R. Y. (2011). Diabetes foot care knowledge: A survey of registered nurses. *Journal of Clinical Nursing*, *20*(15–16), 2367–2370.

Soysal, A. (2019). *Tip 2 diyabetli hastalarda diyabet bilgi düzeyi, sağlık okuryazarlığı ve diyabet öz yönetiminin glisemik kontrole etkisinin değerlendirilmesi*, Tıpta Uzmanlık Tezi, Eskişehir Osmangazi Üniversitesi.

Sucu, G., Dicle, A., & Saka, O. (2012). *Decision Making in Clinical Nursing: Decision-Making Models and Affecting Factors*. *9*(1), 52–60.

The NICE-SUGAR Study Investigators for the Australian and New Zealand Intensive Care Society Clinical Trials Group and the Canadian Critical Care Trials Group. (2015). Intensive versus conventional glucose control in critically ill patients with traumatic brain injury: Long-term follow-up of a subgroup of patients from the NICE-SUGAR study. *Intensive Care Medicine*, *41*(6), 1037–1047.

Thomas, E. (2004). *Survey reveals shortfall in paediatric nurses' knowledge of diabetes. 8*(6), 217–221.

Toraman, K. (2019). *İç hastalıkları kliniklerinde çalışan hemşirelerin diyabet farkındalığı ve diyabetli hastalara yaklaşımlarının incelenmesi*, Yüksek Lisans Tezi, Sakarya Üniversitesi.

Valk, T., & McMorrow, C. (2020). Managing hyperglycemia during the COVID-19 pandemic: Improving outcomes using new technologies in intensive care. *SAGE Open Medicine*, *8*, 2050312120974174.