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THE IMPORTANCE OF PRACTICAL EDUCATION AND INTERNSHIP IN RADIOTHERAPY TECHNICIAN EDUCATION*
RADYOTERAPİ TEKNİKERLİĞİ EĞİTİMİNDE UYGULAMALI EĞİTİMİN VE STAJIN ÖNEMİ

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ABSTRACT

The purpose of this study was to assess the practical training provided by associate degree programs in radiotherapy education in the United States, as well as the preparedness of students for internships and their post-internship learning levels. A total of 317 participants, including both face-to-face and online students, as well as graduates of the radiotherapy program, completed a survey consisting of 68 questions. Of the participants, 66.2% were female (n=210) and 33.8% were male (n=107). Lab facilities are available at institutions where the majority of participants (70.3%) have received education. Binary logistic regression tests were used to investigate whether there was a difference between the pre- and post-internship status. It was statistically significant that interns who had experienced professional growth prior to the internship performed better in achieving such gains after the internship ($p<0.05$). The rate of error among participants who underwent laboratory training was 58.4% lower, and the time it took for them to begin working with patients independently was 61.1% less compared to those who were trained in an educational institution with inadequate practical training. Our survey underscores the significance of both theoretical and hands-on training in the education of radiotherapy technicians. Starting internships with theoretical training in a laboratory environment reinforces students' knowledge and improves their success during the internship. This type of training also enhances self-confidence, strengthens their connection to their profession, and prepares them for professional life after graduation.

Keywords: Education opportunities, experience, internship, radiotherapy technician, vocational training

ÖZ

Ülkemizde radyoterapi eğitimi veren önlisans programlarının uygulamalı eğitimleri ile öğrencilerin staja hazır bulunuşlukları ve staj sonrası öğrenme düzeylerinin değerlendirilmesi amaçlanmıştır. Radyoterapi programında okuyan önlisans öğrencilerine ve mezunlarına yüz yüze ve online olarak uygulanan 68 soruluk anket değerlendirmeye alınmıştır. Ankete toplam 317 kişi katıldı. Katılımcıların %66.2'si kadın (n=210) ve %33.8'i erkektir (n=107). Katılımcıların %70.3'ünün eğitim gördüğü kurumlarda laboratuvar olanakları mevcuttur. Staj öncesi ve sonrası durumun karşılaştırılmasında fark bulunup bulunmadığı binarylojistik regresyon testleri kullanılarak araştırılmıştır. Staj öncesinde mesleki kazanımlar yaşamalarının staj sonrasında bu kazanımları daha iyi elde etmelerini sağladığı istatistiksel olarak anlamlı bulunmuştur ($p<0.05$). Laboratuvar eğitimi alan katılımcıların hata oranı ve tek başına hasta almaya başlama süresi, uygulama eğitimi yetersiz olan bir eğitim kurumunda eğitim alan katılımcılara göre istatistiksel olarak sırasıyla %58.4 ve %61.1 daha azdı. Araştırmamız, radyoterapi teknikerlerinin eğitiminde hem teorik hem de pratik eğitimin gerekli olduğunu göstermektedir. Öğrencilerin aldıkları bilgileri laboratuvar ortamında teorik eğitimle pekiştirerek staja başlamaları staj süresince daha başarılı olmalarını sağlamaktadır. Staj eğitimi ile öğrenciler özgüven kazanır, mesleğine daha yakın hisseder ve iş hayatına hazır hale gelir.

Anahtar kelimeler: Eğitim imkanları, tecrübe, staj, radyoterapi teknikeri, mesleki eğitim

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INTRODUCTION

Health services associate degree programs are in high demand in recent years, as students interested in the health field seek out opportunities to advance their education. The number of students enrolling in these programs continues to increase, reflecting the growing need for skilled professionals in the health industry. The radiotherapy program specifically trains technicians to work in oncology clinics, preparing them for a career in this vital area of healthcare. Radiotherapy technicians must undergo a rigorous and disciplined training process to perform a crucial role in treating cancer patients who are experiencing a challenging period in their lives.[1]

According to the statistics of the 2022-Higher Education Institutions Examination (YKS) of the Council of Higher Education (YOK) Atlas, there are 9 state universities, 18 foundation universities and 4 foundation universities in our country. Out of the total radiotherapy program quota of 1854, 1794 candidates registered. Of the registered candidates, 485 chose state universities, 1235 chose foundation universities, and 74 chose foundation universities in Cyprus.[2] Although the number of hospitals and healthcare centres has increased in our country over the past decade, the Radiotherapy department has not seen a proportional rise in staffing levels. The shortage of qualified personnel remains a concern.[1] It is becoming progressively challenging for recent graduates to secure employment. To address this issue, it is crucial to develop more highly qualified professionals and prepare individuals to begin working immediately upon completion of their studies with respect to their technical expertise and knowledge. Participation in internships affords students the opportunity to acquire professional skills, acclimate to their profession, and gain intimate familiarity with their respective fields.[3]

Radiotherapy technicians operate linear accelerator (Linac) devices to treat oncology patients. Technical abbreviations will be explained upon their first usage. Working with Linac devices, which are radiation-generating devices, requires prior knowledge of radiation protection and treatment methods. It is imperative to use objective evaluations, clear and concise language, a conventional structure, and appropriate academic language. This includes neutral, high-level language that is free from biased or ornamental terminology and avoids first-person perspectives. Additionally, adhering to a consistent citation and footnote style, and ensuring grammatical accuracy, precision in word choice, and logical structure is vital.[3] While deficiencies in acquiring skills during face -to-face education are well-documented, the rise of distance or hybrid education due to the pandemic has resulted in new challenges. For example, radiotherapy technicians may be unable to participate in practice courses, or the number of practice courses they can take may decrease.[4] With the rising number of students, the challenges in securing internships have raised concerns about declining technician training quality.

The purpose of this study is to evaluate the preceptorship provided by associate degree programs that offer radiation therapy education in the country, the preparation of students before, during, and after their preceptorship, and the level of learning after their preceptorship.

MATERIAL AND METHODS

The study surveyed associate degree students and graduates of the Radiotherapy program with a questionnaire approved by the Altınbaş University Ethics Committee (02.03.2023-46353), conducted in adherence to the principles of the Declaration of Helsinki. Since no prior studies on this subject have been conducted, we ensured the content validity of the questionnaire by utilizing the Kendall coefficient of agreement W correlation test with a p-value greater than 0.05.

Kaiser-Meyer-Olkin (KMO) and Barlet Spherty test were used to determine whether the data were suitable for factor analysis. As the data were found to be suitable for factor analysis (KMO: 0.893; $p<0.01$), exploratory factor analysis was used to examine the construct validity and factor structure of the scale, Principal Components as a factorization technique, and Varimax Axis Rotation Method was used to form factors for interrelated variables. These factors explain 71.987% of the total variance. Since the first factor is related to the problemsolving skills of the instructors, this factor is named as "Competence" and explains 18.231% of the total variance. The second factor explains 17.315% of the total variance. Since this factor includes variables related to the professional knowledge and expertise of the instructors, it is named as "Behavior". The third factor explains 31.187% of the total variance and this factor is named as "Learning level" because it includes the attitudes of the lecturers towards the students.

The reliability test revealed a Cronbach Alpha value of 0.842 in our pilot study, indicating high reliability, and was then applied to the full-scale survey with a reliability range of $0.60 \leq \alpha \leq 0.80$, indicating high reliability. The survey was conducted in both face-to-face and online formats. The online survey was supported by the Radiotherapy Technologists Association (RTT-Der). The research study participants were informed of the study, and volunteers were included. Volunteer participants provided their consent.

The first part of the questionnaire included demographic questions regarding age and gender, while the second part consisted of questions 4-25, which aimed to assess the participants' proficiency levels prior to the internship. These questions focused on the continuation of their education, the school and program they attended, and the educational opportunities available at their institution. When evaluating educational opportunities, objective and measurable criteria were prioritized, particularly for positions that require physical dexterity during internships and practical application. The third portion of the evaluation consisted of questions numbered 26 to 39, containing demographic information about the internship site, while the final section spanned questions 40 to 68. The survey aimed to assess student behavior and professional skill acquisition during the internship. To accomplish this, a 5-point Likert scale was utilized when constructing some of the questions.

The survey data was collected and analyzed at a single center using SPSS 28.0. To investigate differences between the situation before and after the internship, binary and multinomial logistic regression tests were conducted in addition to descriptive statistical methods (frequency, percentage). Any results with a $p<0.05$ were considered statistically significant.

RESULTS

A total of 317 participants from 29 Turkish universities, eight of which are state universities, participated in the survey. 66.2% of the participants were female (n=210) and 33.8% were male (n=107). The mean age ranged from 79.2% to 18-24 (n=251). 16.7% are 25-31 years old, 1.9% are 32-38 years old, 1.9% are 39-45 years old, and the rest are 46 years old and over. 52.1% of the respondents are graduates (n=165), 47.9% are continuing their education (n=152).

In the second section of the survey, we aimed to assess the effectiveness of offering ample practical experience and opportunities to adequately prepare participants for their internship. Table 1 displays the responses and corresponding percentages of participants regarding the services provided by their educational institutions. The percentage representation of the fixation devices that the participants could use during the training is given in Figure 1.

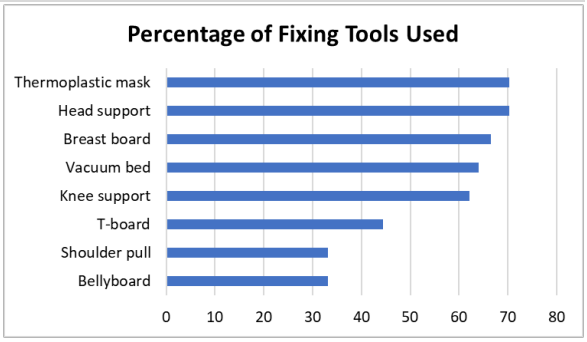

Figure 1: Fixing tools that participants can use during their training

46.4% of respondents reported facing challenges in securing an internship placement (n=147), while 30.6% had to pay a fee to participate in an internship program (n=97). Private hospitals provided internship opportunities for 59.6% of participants (n=189), compared to 40.4% in public hospitals (n=128). Notably, 46.7% of respondents expressed confidence in their ability to administer patient care at the commencement of their internship (n=148). Of the participants, 28.7% completed a 20-day internship, 58.7% completed a 30-day internship, and 12.7% completed an internship lasting 60 days or more. The

Table 1. The feedback was given by the participants to the questions about the training they received

Questions		Yes	No
Did your school have a radiotherapy laboratory?	n	223	94
	%	70.3	29.7
Was there a real Linac in the lab before the internship?	n	45	272
	%	14.2	85.8
Was there a virtual Linac in the lab before the internship?	n	59	258
	%	18.6	81.4
Was there any fixing equipment in the laboratory before the internship?	n	235	82
	%	74.1	25.9
Did you determine the isocentre in the laboratory before the internship?	n	183	134
	%	57.7	42.3
Did you make a mask in the laboratory before the internship?	n	186	131
	%	58.7	41.3
Did you prepare a lead block in the laboratory before the internship?	n	53	264
	%	16.7	83.3
Did you do a bolus in the laboratory before the internship?	n	95	222
	%	30	70
Did you make a vacuum bed in the laboratory before the internship?	n	177	140
	%	55.8	44.2
Did you set up a patient in the laboratory before the internship?	n	198	119
	%	62.5	37.5
Were you able to use Linac in the laboratory before the internship?	n	15	302
	%	4.7	95.3
Did you make effective use of the radiotherapy laboratory?	n	52	265
	%	38.2	61.8

duration of internships varied among participants; 10.7% completed internships lasting 1-4 hours, 27.4% completed internships lasting 4-6 hours, 54.9% completed internships lasting 6-8 hours, and 6.9% completed internships lasting more than 8 hours. Refer to Table 2 for the participants' responses to questions about their internship experiences.

It was tried to measure the level of the participant's ability to obtain the necessary gains for their needs in their working life according to the 5-point Likert scale before and after the internship. In this part, the answers given to the questions asked to the participants are shown in Table 3.

Table 2. Feedback is given by the participants to the questions about their internship experiences

Questions		Definitely not	Not really	No idea	Up to a point	More than enough
I did an internship in the department appropriate to the education I received.	n	7	13	13	95	189
	%	2.2	4.1	4.1	30	59.6
I had the opportunity to apply the theoretical knowledge I learned at school during my internship and I reinforced my understanding.	n	3	7	8	240	59
	%	0.9	2.2	2.5	75.7	18.6
I observed that there is a parallelism between the theoretical education given at the school and the practices in the enterprises.	n	10	14	18	231	44
	%	3.2	4.4	5.7	72.9	13.9
After my internship, my interest in the department I studied increased.	n	3	7	12	238	57
	%	0.9	2.2	3.8	75.1	18
My internship was helpful in getting to know business life.	n	2	7	4	226	78
	%	0.6	2.2	1.3	71.3	24.6
My internship increased my self-confidence professionally.	n	2	6	6	235	68
	%	0.6	1.9	1.9	74.1	21.5
I believe my internship will contribute to my success in my business life after graduation.	n	2	8	8	230	69
	%	0.6	2.5	2.5	72.6	21.8
When I returned to school at the end of the internship, positive changes occurred in my perspective on lessons and subjects.	n	1	7	11	234	64
	%	0.3	2.2	3.5	73.8	20.2
I gained experience in human relations in general and health personnel-patient relations in particular.	n	1	5	5	237	69
	%	0.3	1.6	1.6	74.8	21.8
My internship contributed positively to my desire to work in health services.	n	2	6	7	231	71
	%	0.6	1.9	2.2	72.9	22.4
I had the opportunity to get to know health services through my internship.	n	2	3	5	237	70
	%	0.6	0.9	1.6	74.8	22.1
I consider the internship period sufficient to improve my professional skills.	n	1	9	7	245	55
	%	0.3	2.8	2.2	77.3	17.4
I gained experience in the division of labour and coordinated work.	n	2	7	3	243	62
	%	0.6	2.2	0.9	76.7	19.6
I received the necessary support to learn during my internship.	n	4	3	7	226	77
	%	1.3	0.9	2.2	71.3	24.3
Do you have too much workload on you?	n	39	231	13	31	3
	%	12.3	72.9	4.1	9.8	0.9
Has your learning decreased because of the backlog because more interns work at the same internship?	n	39	226	13	31	8
	%	12.3	71.3	4.1	9.8	2.5
Did you work as a permanent staff rather than a trainee student during your internship?	n	28	37	209	39	4
	%	8.8	11.7	65.9	12.3	1.3
Have you done any applications that you did not learn in internship applications?	n	18	28	200	48	23
	%	5.7	8.8	63.1	15.1	7.3
Have you been expected to do business above your level?	n	42	230	15	25	5
	%	13.2	72.6	4.7	7.9	1.6
Have you been subjected to verbal insults at the internship site?	n	281	20	6	10	0

Table 3. Comparison of the learning levels of the participants regarding professional experiences before and after the internship

Questions			Definitely not	Not really	No idea	Up to a point	More than enough
My level of learning to determine isocenter	Before Internship	n	13	21	15	239	29
		%	4.1	6.6	4.7	75.4	9.1
	After Internship	n	14	15	12	107	169
		%	4.4	4.7	3.8	33.8	53.3
My level of knowing how to make masks	Before Internship	n	13	17	18	233	36
		%	4.1	5.4	5.7	73.5	11.4
	After Internship	n	19	17	13	83	185
		%	6	5.4	4.1	26.2	58.4
My level of knowing how to use blocks	Before Internship	n	38	27	206	32	14
		%	12	8.5	65	10.1	4.4
	After Internship	n	57	41	40	93	86
		%	18	12.9	12.6	29.3	27.1
My level of knowing how to make a vacuum bed	Before Internship	n	16	21	198	53	29
		%	5	6.6	62.5	16.7	9.1
	After Internship	n	44	28	11	95	139
		%	13.9	8.8	3.5	30	43.8
My level of knowledge of bolus	Before Internship	n	21	36	207	33	20
		%	6.6	11.4	65.3	10.4	6.3
	After Internship	n	48	38	25	104	102
		%	15.1	12	7.9	32.8	32.2
My level of knowing how to use CT	Before Internship	n	27	25	205	47	13
		%	8.5	7.9	64.7	14.8	4.1
	After Internship	n	16	34	33	99	135
		%	5	10.7	10.4	31.2	42.6

After completing the internship, we conducted a paired-sample t-test to statistically analyze the level of knowledge gained in professional experiences, including isocenter determination, mask preparation, lead block making, vacuum bed preparation, bolus preparation, and computed tomography (CT) scanning. The analysis was conducted based on the participants' prior experience in these areas before starting the internship. Our null hypothesis (H0) was that there would be no statistically significant difference in knowledge before and after the internship. H1: "Significant Difference Found Between Before and After Internship" A statistically significant difference was observed between the levels of professional competency before and after the internship ($p<0.05$). Table 4. presents the obtained data.

The authors conducted a binary logistic regression analysis to examine the association between laboratory training status, internship location, and three measures of professional development: skill knowledge acquired after the internship, internship mistakes, and time to independently manage patients during the internship. The evaluation was conducted objectively, without subjective evaluations, and technical term abbreviations were explained upon first use. The authors employed clear, objective, and value-neutral language, avoiding biased or emotional language. They adhered to a conventional academic structure, including common sections and maintaining regulatory formatting. The text was free from grammatical errors and unnecessary jargon, using high-level, standard language. Finally, the authors aimed for clear structure with a logical progression, including causal connections between statements. The dependent variables selected were whether participants received laboratory training during their education and where they completed their internship, whether in a public or private hospital. Table 5 displays the obtained data, with being in a laboratory and completing an internship in a public hospital chosen as the reference category.

The acquisition of professional skills during internships can be better understood by examining whether participants received laboratory training during their education, which explains 20.4% of the variation (Nagelkerke R square). Analyses indicate strong agreement in questionnaire data (94.2%) (Hosmer &Lemeshow Test Sig Value). Furthermore, significant differences were observed in the level of determining isocenter based on laboratory status

Table 4. Paired sample t test results of professional competencies obtained before and after internship

	Paired Samples Test			
Professional experience expected to be gained	Mean	Fark	t	Two-sided p
Level of learning to determine isocenter	3.7886	-0.47950	-6.962	0.000
	4.2681	-0.42902	-5.824	0.000
Knowing how to make masks	3.8265	-0.48265	-5.986	0.000
	4.2555	-0.62776	-6.871	0.000
Knowing how to use blocks	2.8644	-0.56467	-6.755	0.000
	3.3470	-0.97476	-13.378	0.000
Knowing how to make a vacuum bed	3.1830	-0.47950	-6.962	0.000
	3.8107	-0.42902	-5.824	0.000
Knowing how to make bolus	2.9842	-0.48265	-5.986	0.000
	3.5489	-0.62776	-6.871	0.000
Knowing how to use CT	2.9811	-0.56467	-6.755	0.000
	3.9558	-0.97476	-13.378	0.000

Table 5. Binary logistic regression analysis results of professional competencies according to being a laboratory and internship place

	According to the status of being a laboratory before the internship						By internship place					
Professional experience expected to be gained	Cox & Snell R Square	Nagelkerke R Square	Hosmer& Lemeshow Test Chi-square	Hosmer& Lemeshow Test Sig			Cox & Snell R Square	Nagelkerke R Square	Hosmer& Lemeshow Test Chi-square	Hosmer& Lemeshow Test Sig		
	0.144	0.204	2.870	0.942			0.157	0.213	3.733	0.880		
					95% C.I.forExp(B)						95% C.I.forExp(B)	
	B	Wald	Sig.	Exp (B)	Lower	Upper	B	Wald	Sig.	Exp (B)	Lower	Upper
Level of learning to determine socenter	-1.668	5.950	0.001	0.431	1.388	20.255	-0.160	0.210	0.026	0.64	0.430	1.689
Knowing how to make masks	-0.443	1.115	0.001	0.499	0.282	1.461	0.276	0.181	0.024	0.653	0.369	4.708
Knowing how to use blocks	-0.700	3.380	0.001	0.546	0.955	4.247	0.439	2.403	0.001	0.661	0.490	2.705
Knowing how to make a vacuum bed	-1.031	3.446	0.001	0.433	0.120	1.059	-0.784	5.311	0.073	0.743	0.235	0.889
Knowing how to make bolus	-0.678	3.274	0.001	0.424	0.145	4.105	0.595	3.033	0.003	0.675	0.428	3.542
Knowing how to use CT	0.624	2.397	0.001	0.41	0.147	4.109	-0.452	2.468	0.025	0.709	0.362	1.118
Error status	-0.103	0.503	0.001	0.416	0.135	1.471	0.085	0.395	0.001	0.666	0.435	1.419
The ability to take a patient alone	0.378	2.902	0.001	0.389	0.145	2.255	-1.052	20.532	0.007	0.72	0.221	0.550
Costant	-0.971	8.905	0.003	0.379			0.143	0.298	0.004	1.153		

($p<0.05$). Those who received laboratory training show a significant improvement in learning isocenters, with an Exp(B) value of 5.302. The statistical analysis revealed that the professional skills gained after the internship were significantly higher ($p=0.003<0.05$) in the group that underwent laboratory training, where the effect size was calculated at 0.379 (Exp(B)).

We can account for 21.3% (Nagelkerke R squared) of the variance in professional skill acquisition after internships based on participants' sector of internship. The logistic regression model yielded a Hosmer&Lemeshow Test Sig value of 88.0% compatibility. We found a significant difference in vacuum bed proficiency between interns in the public and private sectors ($p<0.05$). Those who completed their internship in the public sector demonstrated 0.457 times (Exp(B)) higher proficiency with the vacuum bed. Those who completed their internship in the public sector demonstrated 0.457 times (Exp(B)) higher proficiency with the vacuum bed. The time required to begin working with patients independently was significantly different ($p < 0.05$) for participants with a public sector internship. These individuals initiated independent patient care 0.349 times (Exp(B)) sooner than their peers. In general, there was no statistically significant difference ($p=0.585>0.05$) in the level of professional skill acquisition among public internship students after the internship.

The professional skills acquired by the participants after the internship were evaluated through multinominal logistic regression analysis, taking into consideration the varying duration of the internships. The dependent variable for the analysis was the duration of the participants' internships. Table 6

presents the obtained data. The reference category for the analysis was the group with internships lasting 60 days or more.

Likelihood Chi-Square and Sig values of 168.125 and 0.000, respectively, indicate a statistically significant model. Furthermore, with a Pearson Chi-Square of 832.6 and p-value of 0.000<0.005, we can confirm that the model is suitable for evaluation. Additionally, the Pearson Chi-Square value was divided by the df value of 591 to obtain a value of 1.41 for the evaluation of the complete separation problem, which indicates the absence of such a problem. According to our model, the increase in internship duration can explain 41.2% and 47.4% of the increase in professional skill

Table 6. Multinominal logistic regression analysis results of professional competencies according to internship duration

stajsure[a]		B	Std. Error	Wald	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
20 days	Level of learning to determine isocenter	-17.05	0.880	375.706	0.000	25520361.476	4549092.136	143168973.143
	Knowing how to make masks	1.580	1.658	0.908	0.341	4.857	0.188	125.329
	Knowing how to use blocks	1.814	1.047	3.002	0.083	6.132	0.788	47.703
	Knowing how to make a vacuum bed	1.641	1.207	1.847	0.174	5.161	0.484	55.019
	Knowing how to make bolus	1.045	1.517	0.474	0.491	2.843	0.145	55.631
	Knowing how to use CT	-6.478	1.896	11.670	0.001	0.002	3.739E-05	0.063
	Error status	-0.759	0.613	1.533	0.216	0.468	0.141	1.556
	The ability to take a patient alone	-1.310	0.814	2.586	0.108	0.270	0.055	1.332
30 days	Level of learning to determine isocenter	-1.958	1.033	3.591	0.058	7.083	0.935	53.657
	Knowing how to make masks	2.988	1.696	3.103	0.078	19.841	0.714	551.069
	Knowing how to use blocks	-1.731	1.032	2.814	0.093	0.177	0.023	1.338
	Knowing how to make a vacuum bed	2.162	1.191	3.293	0.070	8.688	0.841	89.763
	Knowing how to make bolus	-1.096	0.872	1.579	0.209	0.334	0.060	1.847
	Knowing how to use CT	-6.052	1.852	10.683	0.001	0.002	6.242E-05	0.089
	Error status	-0.777	0.585	1.762	0.184	0.460	0.146	1.448
	The ability to take a patient alone	0.211	0.742	0.081	0.776	1.235	0.288	5.290
60 days	Level of learning to determine isocenter	2.399	1.438	2.782	0.095	11.016	0.657	184.686
	Knowing how to make masks	3.957	2.494	2.517	0.113	52.316	0.394	6945.453
	Knowing how to use blocks	-2.450	1.717	2.035	0.154	0.086	0.003	2.500
	Knowing how to make a vacuum bed	2.391	1.551	2.377	0.123	10.924	0.523	228.333
	Knowing how to make bolus	-0.641	1.333	0.231	0.630	0.527	0.039	7.177
	Knowing how to use CT	-2.969	2.283	1.691	0.193	0.051	0.001	4.509
	Error status	-1.840	0.943	3.809	0.051	0.159	0.025	1.008
	The ability to take a patient alone	2.555	1.281	3.976	0.046	12.870	1.045	158.555

The reference category is: 60days and above
Pearson Chi-Square=832.6
Pearson p=0.000<0.005
Likelihood Chi-Square = 168.125
Sig=0.000
Cox and Snell R-Square=0.412
Nagelkerke R-Square=0.474

knowledge. Cox and Snell R-Square was 0.412 and Nagelkerke R-Square was 0.474.

The level of learning the isocentric determination was significantly lower among individuals who completed internships of 20 days (B=-17.05; Wald=375.706; p=0.000) and 30 days (B=-1.958; Wald= 3.591; p=0.058) compared to those with internships lasting 60 days.

The proficiency in utilizing CT is significantly lower among individuals who completed 20 days (B=-6.478; Wald=11.670; p=0.001) and 30 days of internship (B=-6.052; Wald=10.683; p=0.001) in comparison to those who completed 60 days of internship.

DISCUSSION

Radiotherapy is one of the most preferred treatment methods in cancer treatments. The success of the treatment depends on good planning and the correct application of the treatment to the patient. In order to ensure that this planning is carried out correctly, the radiotherapy technician must ensure that the patient remains motionless, fixed and in the same position during the treatment. Fixing devices are used in clinics for this. Learning to use this equipment correctly for the right disease is part of the student's educational process. Internships are important for students to transfer the knowledge they have learned in the lessons into practice and to develop their skills.[3,5] For this reason, we evaluated by surveying practice and internship training and opportunities in the light of statistical data based on survey data about associate degree programs providing radiotherapy education in our country.

Facilities are available in institutions where 70.3% of the participants are educated. However, before the internship, 85.8% of the participants did not see a real link. Virtual simulation programs have been actively used in education in Europe since 2007.[6] With the virtual training program that has just started to be used in our country, 18.6% of the participants had the opportunity to see a virtual link before the internship. However, the number of people who can use the linac device before the internship is quite low (4.7%). He thinks that the use of virtual education programs will increase in the coming years.[4] It is thought that the spread of virtual education is related to the fact that the number of students is much higher than the number of clinics that can do internships. As Hoşgor mentioned in his study on the use of virtual reality, it is thought that virtual education applications will provide more effective and permanent learning compared to traditional methods.[7] Although the majority of the participants (74.1%) reported that they had seen the fixation equipment in the laboratory before the internship, 38.2% thought that they did not use the laboratories effectively. As a result, 53.3% of the participants reported that they did not find themselves sufficient when starting the internship. As in Yuksel's study for Electroneurophysiology and the first half of the emergency program students,[5] it is thought that this situation can be improved by developing and increasing the applied education in accordance with its purpose.

94.3% of the participants stated that they could use the information they received from their theoretical training during their internship. Similarly, 86.8% of the participants stated that there is a parallelism between theoretical training and the practices in the enterprises. This shows that the participants received a good theoretical education. Similar results were observed in Yenal and Gultekin's study and Tunc and Dal's study for students studying in different programs of health vocational school.[3,8]

53.6% of the participants had difficulty finding an internship place and 69.4% paid for the internship, they reported that the internship contributed positively to their department, their profession and their self-confidence after the internship. The duration of the internship of the participants varies. While some students did their internships more, some of them were able to complete their internship in much shorter periods (28.7% 20 days, 58.7% 30 days, 12.7% 60 days and more and 10.7% ' 1-4 hours, 27.4% 4-6 hours, 54.9% 6-8 hours). This is an indication of the lack of equality of opportunity. However, 94.7% of the participants think that the internship period is sufficient.

Participants stated that they gained experience in the division of labour and coordination during the internship, received support for learning from other technicians and did not encounter any bad situations (see Table 2).

The contribution of laboratory practice activities in gaining professional experience was found to be statistically significant ($p<0.05$) (see Tables 3). The learning levels of the participants, who saw important professional practices in the laboratory environment before the internship, such as determining isocentre, mask, block, vacuum bed, bolus and patient set-up after the internship were 56.9%; 50.1%; 45.4%; 56.7%; 57.6% and 59% were found to be statistically better. The rate of making mistakes and the time to start taking patients on their own were statistically 58.4% and 61.1% less, respectively than those who received training in an educational institution with insufficient practical training (see Table 5).

The importance of the internship place in gaining professional experience has been examined statistically. Those who do internships in private hospitals are 36% in terms of knowing how to determine isocenter, make a mask, make a block, make a bolus and use a CT; 34.7%; 33.9%; 32.5% and 29.1% are statistically better. However, no statistically significant result was obtained in terms of knowing how to make a vacuum bed ($p>0.05$).

Professional experience was analyzed through multinominal logistic regression, taking into account the duration of interns' placements. The study determined that individuals who completed an internship lasting 60 days or more had significantly higher levels of learning compared to those who completed shorter internships of 20 or 30 days (see Table 6). Interns were required to demonstrate technical skills including isocenter determination, mask, block, vacuum bed and bolus making. Furthermore, interns who completed longer placements were able to start taking patients independently 12 times sooner. A study by Gokce and Yildiz revealed that graduate students highlighted the inadequacies in the duration of internships, absence of

laboratories in schools, and insufficient guidance and psychological support.[9]

The high number of patients in public hospitals and the high number of trainee students who prefer these hospitals make us think that vocational skills are not fully learned by the students in these hospitals. It is thought that the number of interns in private hospitals is less and the interns who come for training are more closely involved, so students are more successful here.

It has been observed that the students are provided with a suitable environment for learning, they are helped in their mistakes and they receive the necessary support at the internship places. It was observed that they were not employed in side jobs during the internship, they integrated and adopted the clinic. However, the number of interns who receive job offers after the internship is quite low. It is thought that this situation arises not from the inadequacies of the students but from the lack of clinical need.

CONCLUSION

Our survey shows that both theoretical and practical training are important in the training of radiotherapy technicians. Students starting internships by reinforcing the knowledge they have acquired through theoretical training in the laboratory environment makes them more successful. Even if the institutions that provide radiotherapy training have their hospital, performing professional practices in a laboratory will make them more successful in their internships and working lives. Hybrid training, which has gained importance and become digital in recent years, and some compulsory virtual training have been adapted for radiotherapy.[7] Systems have been developed that allow students to practice the features of the device by projecting the image of the device onto a wall in a real room. These systems are combined with virtual reality (VR) glasses, allowing the student to realize the technical capabilities of the device with a more realistic perception and to show the options of preparing and treating a patient for treatment.[10] Supporting education with such practices will pave the way for the training of more successful and more accurate technicians. It has been observed that the students are provided with a suitable environment for learning, they are helped in their mistakes and they receive the necessary support at the internship places. It was observed that they were not employed in side jobs during the internship, they integrated and adopted the clinic. With internships, students gain self-confidence and feel closer to their profession and become ready for business life.

Ethics Committe Aproval: This study was conducted in accordance with the guidelines set forth in the Declaration of Helsinki. All procedures involving human participants were approved by the Altınbaş University Ethics Committee (numbered 02.03.2023-46353).

Informed Consent: Verbal consent from participants taken.

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REFERENCES

1. Becerir HB, Gurdalli S, Yapici B, et al. Radiotherapyequipment and work force in *Turkey. Turk J Oncol.* 2021;36(4):512-518. doi:10.5505/tjo.2021.2896
2. All Universities with Radiotherapy Programs. Higher Education Institution. https://yokatlas.yok.gov.tr/onlisans-program.php?b=30061. Published 2022. Accessed May 21, 2023.
3. Yenal S, Gultekin T. Sağlık hizmetleri meslek yüksekokulu son sınıf öğrencilerinin klinik uygulamalarda karşılaştıkları güçlükler. *İnönü Üniversitesi Sağlık Hizmetleri Meslek Yüksek Okulu Dergisi.* 2019;7(1):58-66. doi:10.33715/inonusaglik.547551
4. De Almeida RPP, Da Silva CA, Da CostaVicente BI, Abrantes AFCL, Azevedo KB. The paradigm shift in medical imaging education and training in Europe. *IJIET*. 2022;12(4):326-332. doi:10.18178/ijiet.2022.12.4.1622
5. Yüksel A. Sağlık hizmetleri meslek yüksekokulu öğrencilerinin uygulamalı derslere ilişkin görüşleri. *JOHSE*. 2018;2(2):72-77. doi:10.26567/JOHSE.

2018250153
6. Flinton D. Competency based assessment using a virtual environment for radiotherapy. *Procedia Comput Sci.* 2013;25:399-401. doi:10.1016/j.procs.2013.11.049
7. Hosgor H. Sağlık hizmetleri alanında sanal gerçekliğin kullanımı: Türkiye ve dünyadan örnekler. *Fenerbahçe Üniversitesi Sağlık Bilimleri Dergisi.* 2022;2(3):647-660. doi:10.56061/fbujohs.1151900
8. Tunc Y, Dal M. Sağlık hizmetleri meslek yüksekokulu öğrencilerinin yaz stajı Hakkındaki Görüş ve Önerileri: Iğdır Üniversitesi örneği. *Researcher: Social Science Studies.* 2018;6(3):377-403. doi:10.18301/rss.683
9. Bostan S, Yildirmis S. Sağlık teknikerleri meslek eğitiminin sektörel değerlendirilmesi. *TISK Akademi Dergisi.* 2008;3(6):280-291.
10. Siddique S, Chow JCL. Artificialintelligence in radiotherapy. *Rep Pract Oncol Radiother.* 2020;25(4):656-666. doi:10.1016/j.rpor.2020.03.015