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RADIOLOGY TECHNICIANS' EDUCATIONAL PROCESS AND THE LEVEL OF ANXIETY OF THE STUDENTS

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Abstract

Aim. We aimed to assess possible relationship between the radiology technician educational process and the levels of anxiety of the students of the first, the second, and the third academic year. The students' self-esteem and attitude to the educational process were covariates.

Methods. The current cross-sectional questionnaire-based study involved 157 participants. GAD-7 questionnaire was selected to check general anxiety. The total score for all items ranges from 0 (minimal anxiety) to 21 (severe anxiety). GAD-7 was reinforced by the radiology student-specific questionnaire (RSSQ) with 29 statements to be graded from 1 to 5. These items were divided into four clusters to check (1) the students' self-esteem, (2) attitude to the educational process, (3) preparedness to stressful situations, and (4) main stressors.

Results. The obtained score of 6.2 ± 1.2 was within 5 – 9 "mild anxiety" segment of GAD-7 scores. The self-esteem of the participants was high (4.3 ± 0.6 out of 5). Their preparedness to stressful situations was good (4.0 ± 0.8). Their reaction to radiology-specific and education-specific stressful factors was above average (3.6 ± 0.7). A significant decline of the reaction to radiology-specific stressors from the first to the third year of education (p=0.05) was noted.

Conclusion. The radiologic science students in this study reported an overall positive emotional well-being. Helping students maintain high levels of emotional health is beneficial for their education.

Keywords: radiology technician, educational process, anxiety, anxiety testing.

TEXNIK-RADIOLOGLARNING O'QUV JARAYONI VA TALABALARNING XAVOTIRLANISH DARAJASI

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Annotatsiya.

Maqsad. Bizning maqsadimiz rentgenologning o'quv jarayoni va birinchi, ikkinchi va uchinchi kurs talabalarining xavotirlanish darajasi o'rtasidagi mumkin bo'lgan munosabatlarni baholash edi. Kovariatsiyalar talabalarning o'z-o'zini baholashi va ta'lim jarayoniga bo'lgan munosabati edi.

Usullari. Joriy anketaga asoslangan kesmaviy tadqiqot 157 ishtirokchini qamrab olgan. GAD-7 so'rovnomasi umumiy xavotirlanishni tekshirish uchun tanlangan. Barcha moddalar uchun umumiy ball 0 (minimal xavotirlanish) dan 21 (qattiq xavotirlanish) gacha. GAD-7 1 dan 5 gacha baholanishi kerak bo'lgan 29 ta mazondan iborat radiologiya talabalari so'rovnomasi (RSSQ) bilan tasdiqlangan.

Natijalar. Olingan 6,2±1,2 ball GAD-7 shkalasi bo'yicha "engil xavotirlanish" segmentining 5-9 balli oralig'ida edi. Ishtirokchilarning o'zini o'zi qadrlashi yuqori edi (5 dan 4,3±0,6). Ularning stressli vaziyatlarga tayyorligi yaxshi edi (4,0±0,8). Ularning radiologik va ta'lim stresslariga javobi o'rtacha darajadan yuqori edi (3,6±0,7). Tadqiqotning birinchi yilidan uchinchi yiligacha rentgen nuriga xos stress omillariga javob sezilarli darajada pasaydi (*p*=0,05).

Xulosa. Ushbu tadqiqotda radiologiya talabalari umumiy ijobiy hissiy farovonlik haqida xabar berishdi. Talabalarga yuqori darajadagi hissiy salomatlikni saqlashga yordam berish ularning bilim olishi uchun foydalidir.

Kalit so'zlar: rentgenolog, o'quv jarayoni, xavotirlanish, xavotirlanish testi.

УЧЕБНЫЙ ПРОЦЕСС ТЕХНИКОВ-РАДИОЛОГОВ И УРОВЕНЬ ТРЕВОЖНОСТИ СТУДЕНТОВ

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Аннотация

Цель. Нашей целью было оценить возможную взаимосвязь между учебным процессом рентгенолога и уровнем тревожности студентов первого, второго и третьего курсов. Ковариантами были самооценка студентов и отношение к образовательному процессу.

Методы. В текущем кросс-секционном исследовании, основанном на вопроснике, приняли участие 157 человек. Для проверки общей тревожности был выбран опросник GAD-7. Суммарный балл по всем пунктам колеблется от 0 (минимальная тревожность) до 21 (сильная тревожность). GAD-7 был подкреплен анкетой для студентов-рентгенологов (RSSQ) с 29 утверждениями, которые должны были быть оценены от 1 до 5. Эти вопросы были разделены на четыре группы для проверки (1) самооценки студентов, (2) отношения к учебному процессу, (3) готовности к стрессовым ситуациям и (4) основные стрессоры.

Результаты. Полученный балл 6,2 ± 1,2 находился в пределах 5-9 баллов сегмента «легкая тревога» по шкале GAD-7. Самооценка участников была высокой (4,3 ± 0,6 из 5). Их готовность к стрессовым ситуациям была хорошей (4,0 ± 0,8). Их реакция на радиологические и учебные стрессогенные факторы была выше средней (3,6 ± 0,7). Отмечено достоверное снижение реакции на рентгеноспецифические стрессоры от первого к третьему году обучения (p=0,05).

Заключение. Студенты-радиологи в этом исследовании сообщили об общем положительном эмоциональном благополучии. Помощь учащимся в поддержании высокого уровня эмоционального здоровья полезна для их образования.

Ключевые слова: рентгенолог, учебный процесс, тревожность, тестирование на стресс.

Introduction. Radiological technicians were recognized as a separate profession during the 1940s [2,18]. Already in the 1950s, it was noted that this profession requires the level of a college education [7]. The publications of the 1960s and 1970s stressed the fact that this profession becomes more and more complex because of the development of nuclear medicine and other imaging modalities [10,19]. These trends intensified and already in 2004, Copeman summarized the difficulties in training and education of radiological technicians in his publication "From X-ray technician to radiologic technologist" [6]. Currently, the USA program for education in radiologic technology involves approximately 950 contact hours of classroom work, 1,770 hours of clinical training, and 288 hours of workshops and independent study [11]. The Israeli education programs follow approximately the same pattern but with lesser number of hours of clinical training.

It is agreed that the educational process in the field of various medical and health care professions may be associated with depression, anxiety, possible low self-esteem, and symptoms of stress [8, 17, 22, 25]. Some publications presented the alarming information that health care students may report having low self-esteem in 19.55%, depression (30.17%), and anxiety (34.64%) [3]. Specifically for radiological technician students, this topic was extremely understudied and only few publications on the subject appeared. Most of them were published just recently in one cluster dedicated to the situation during COVID-19 pandemic [9, 16, 20, 21]. Besides these situation-specific publications, there was an American report that 60% of radiology students reported feeling constantly under strain [5]. In addition, one publication explained that understaffing, instability and affect, episodic experience and feeling "thrown-in", and unpreparedness for the challenging patient may lead to stress among radiological technician students in the UK [14]. No Israel-based research was performed on the subject to date.

In light of the above, it seems to say that there is a connection between radiology technician educational process and the level of anxiety a student may experience. It may be connected with number of hours of teaching and training, nonacademic stressors, lack of communication skills, or radiology-specific stressors [5, 6, 11, 14, 15, 16].

Therefore, in the current study, the following hypotheses will be tested:

1. A possible relationship will be investigated between the radiology technician educational process and the levels of anxiety of the students. The null-hypothesis is that the radiology technician educational process does not influence the levels of anxiety of the students.

2. Possible differences will be found between the students of the first, the second, and the third year of education in relation to the levels of anxiety of the students. The null-hypothesis is that the students of different years of education will demonstrate equal levels of anxiety.

In addition, the students' self-esteem and their attitude to the educational process will be investigated as the secondary predictor variables.

Methods.

Participants. The target population was defined as adult radiology technician students of both sexes. The current prospective, multisite, cross-sectional questionnaire-based study supposed to involve at least 150 participants. The cohort should have at least 50 students per each educational year. Students with disabilities were excluded from the study. Participants were informed that they were under no obligation to participate and that they could withdraw at any time from the study without consequences. Written informed consent was not obtained because the study was fully anonymous.

Instruments (questionnaires). The authors examined various questionnaires that previously were used in anxiety and stress-related studies such as Hopkins Symptom Checklist (HSCL-25), Hamilton Anxiety Rating Scale, Harvard Trauma Questionnaire, Perceived Stress Scale, Beck Depression Inventory, *General Anxiety Disorder-7* (GAD-7), and The Insomnia Severity Index. They were assessed as only partially applicable to the goals of the current research and only GAD-7 questionnaire was selected to check general anxiety. This is a validated and well-established questionnaire with a score ranging from 0 to 3 for each of the seven questions. It estimates the level of anxiety during the last two weeks before the interview. The total score for all items ranges from 0 to 21 with four interpretations as 0–4: minimal anxiety, 5–9: mild anxiety, 10–14: moderate anxiety, and 15–21: severe anxiety.

GAD-7 was reinforced by the radiology student-specific questionnaire (RSSQ) that was designed by the authors (see Appendix). We adopted the 5-point grading system that was used in Perceived Stress Scale and Hamilton Anxiety Rating Scale. The questionnaire consisted of two sections. The first section assessed the demographic characteristics of the respondents (age, gender, and academic year). The second section consisted of the 29-item questionnaire. This section was divided into three clusters. Cluster 1 with items 1 – 6 tested the participants' self-esteem (for example, "You are able to treat the patient independently according to your ability") with the grades from 1 (low) to 5 (high). The score could vary from 30 (high self-esteem, overconfidence) to 6 (very low self-esteem). Cluster 2 united items 7, 16, and 26-28. These items were designed to check the participants' attitude to the educa-

tional process (for example, "I would recommend increasing the hours of clinical experience"). The score for each statement should be analyzed separately and no general score should be estimated. The main cluster of the questionnaire consisted of 18 stress/anxiety-related items (for example, "You are exposed to a variety of patients"). This cluster was divided into two subclusters. Cluster 3a items (8-10, 13-15, 17, 19, 20) were designed to check the participants' preparedness to stressful situations (for example, "I feel that in busy situations the system knows how to back us up if necessary"). The score could vary from 45 (well-prepared) to 9 (unprepared). Cluster 3b items (11, 12, 18, 21-25, 29) were designed to check the participants' stressful factors (for example, "You become anxious before a medical examination that must be done"). The score could vary from 45 (significant stress) to 9 (no stress).

For the pilot study, RSSQ was presented to 10 second-year radiology students who were asked to specify if any item was unclear. After that, the questionnaires were slightly modified and finalized.

Data collection. The data were collected in the radiology technician schools at Shamir (Assaf HaRofeh) Medical Center, Barzilai Medical Center (Ashkelon), Kaplan Hospital (Rehovot), Souraski (Ichilov) Medical Center (Tel-Aviv), and at Bar-Ilan University during the 2022-23 educational year. Retrospective reporting bias, therefore, was minimized because the survey period was concurrent with the ongoing educational process. Data were collected through a self-administered structured online questionnaire developed by Google Forms online survey tool. The pyramid system of data collection ("snowball sampling technique") was designed. The primary investigators had spread the survey tools in a friend-to-friend manner and to the collaborators. The collaborators repeated the same procedure school-specific. Paper-and-pensile questionnaire was distributed in Barzilai and Kaplan hospitals. The returning of the filled forms was done in the same pyramid manner.

The survey was anonymous and all personal data, except age and sex, were not included in the data spreadsheets. Following the research ethics regulations, while the study used mostly online-manner survey, the confidentiality of the participants was maintained in compliance with the requirements of the Data Protection Act 1998 and the subsequent *General Data Protection Regulation (GDPR).* All authors complied with the requirements of the Data Protection Act 1998 and GDPR concerning the collection, storage, processing and disclosure of personal information and upheld the Act's core principles. These included the creation of depersonalized data spreadsheets and secure maintenance of information. At the end of the study, the online survey activities were immediately terminated.

Data analysis. Descriptive analysis was provided to describe basic and general information about the demographic and specific question results. The results include the distribution of survey participants by sex. We calculated

point-biserial correlation coefficients for sex – cluster scores correlation. A correlation coefficient of r≥0.60 was considered as strong. The age of participants was not taken as a variable because the cohort was almost uniform in age. The average scores for Cluster 1, 3a, and 3b were analyzed separately. We used one-way *analysis* of variance (ANOVA) to compare the data from three educational year groups. All statistical analyses were performed using SPSS (version 19.0, SPSS Inc., Chicago, IL). A significance threshold of $p < 0.05$ was used for all analyses.

Results. A total of 157 radiology technician students were included in this questionnaire-based study (average age 21 y 4 mo±1 y 6 mo; Male 52, Female 105) and the response rate of the survey was 73%. The general results of the survey are presented in Table 1.

Table 1

The general results of the survey (average±standard deviation; *n*=157): cluster by cluster RSSQ scores and GAD-7 scores for the students of the first (*n*=54), the second (*n*=51), and the third (*n*=52) year of education.

Tools	Year 1	Year 2	Year 3	TOTAL	p*
RSSQ					
Cluster 1	3.5 ± 0.5	4.6 ± 0.3	4.7 ± 0.6	4.3 ± 0.6	**0.03**
Cluster 2:					
Q 7	3.2 ± 0.4	3.7 ± 0.3	3.9 ± 0.4	3.6 ± 0.5	0.07
Q 16	4.0 ± 0.3	4.2 ± 0.4	4.4 ± 0.6	4.2 ± 0.5	0.12
Q 26	3.3 ± 0.8	1.9 ±0.7	1.7 ± 0.7	2.3 ± 0.8	**0.02**
Q 27	3.3 ± 0.8	2.5 ± 0.8	2.4 ± 0.7	2.7 ± 0.8	0.18
Q 28	3.4 ± 0.9	3.6 ± 0.8	3.9 ± 0.8	3.6 ± 0.8	0.25
Cluster 3a	3.6 ± 0.6	4.0 ± 0.7	4.4 ± 0.9	4.0 ± 0.8	0.24
Cluster 3b	4.2 ± 0.8	3.5 ± 0.7	3.1 ± 0.6	3.6 ± 0.7	**0.05**
GAD-7	6.8 ± 1.3	6.1 ± 1.1	5.6 ± 1.1	6.2 ± 1.2	0.47

*Comparison between the first and the third year of education.

A.   GAD-7 results demonstrated that tested students experienced low anxiety. The obtained score of 6.2±1.2 is within 5 – 9 "mild anxiety" segment of GAD-7 scores.

RSSQ results presented more specific information. The self-esteem of the participants appeared to be high (4.3±0.6 out of 5). Their preparedness to stressful situations was also good (4.0±0.8). Their reaction to radiology-spe-

cific and education-specific stressful factors was somewhat above average (3.6±0.7).

Therefore, testing the hypothesis of a connection between the educational process and the level of anxiety, the results demonstrate that radiology educational process is not stressful.

Conclusion: Hypothesis is confirmed only partially. Students experience some level of anxiety, but this anxiety is not high.

B. Testing the hypothesis of differences between students of three consecutive years of education, our GAD-7 results demonstrated a gradual decline of anxiety level of participants from the first to the third year of education. This decline, however, was not statistically significant (6.8±1.3 vs. 6.1±1.1, p=0.63; 6.8±1.3 vs. 5.6±1.1, p=0.47). The RSSQ results for Cluster 3b, however, demonstrated significant decline of the reaction to radiology-specific stressors from the first to the third year of education (*p*=0.05) (Table 1). At the same time, the students' self-esteem significantly elevated during the education period (*p*=0.03).

Conclusion: The tendency for reduction of anxiety level to the end of the educational period is observed. The null-hypothesis that the students of different years of education will demonstrate equal levels of anxiety was rejected.

Questions of Cluster 2 of the RSSQ questionnaire tested the students' attitude to the educational process itself. While integration between the theoretical material and practical experience (question 16) was assessed positively (4.2±0.5), the other elements of the educational process left students undecided. The questions of adding protocols or reducing or elevating the number of hours of clinical practice received unclear scores between 2.7±0.8 and 3.6±0.8 that is around average score of 3. The only statistically significant longitudinal change can be seen in the issue of increasing the hours of clinical experience. In comparison with the first-year students, the third-year students were definitely against this (*p*=0.02).

Discussion. Our research is the first Israel-based study of anxiety issues among radiology technician students. Radiographers are in the 'front line' of patient care. Patients often have more interaction with radiographers than with physicians or other medical specialists. An adequate educational process may reduce anxiety among the students and increase the chances of producing optimal results from an examination at the first attempt, thus reducing radiation exposure, patient discomfort and the overall cost of conducting the procedure [13]. It was demonstrated that good working climate, good reputation of the institute, and personal recognition are important factors for job satisfaction and motivation of employed radiology technicians [23]. We can add that good working climate during the educational process of radiology technicians is also very important. In medical professions, practical education includes hands-on

training and practical training that is stressful by definition. Already employed radiology technicians also may experience perceived stress [1].

Our results indicated that radiology technician education in Israel is well-organized and well-managed. That is why the students demonstrated high self-esteem, mild anxiety levels, and moderate reaction to radiology-specific stressors.

There were several publications reporting that final year undergraduate radiography students and other health care students manage stress and anxiety better than first-year students [4, 14, 16]. In general, our results confirm this statement as we traced insignificant decline of the GAD-7 anxiety levels and significant decline of RSSQ stress-related scores during the three years of education.

British authors indicated an increasing demand on diagnostic imaging departments, a shortage of radiologists, and a backlog of images requiring a report across several trusts in the UK [24]. The situation is only slightly better in the USA [5]. Employers and educators recognize the widening transition-to-practice gap in meeting expectations for practice-ready, resilient radiology technicians. An increasing demand on diagnostic imaging departments is observed in Israel as well. Further research might investigate collaboration between academic institutions and clinical sites in Israel, clinical stress experienced by radiography students, stress-management, and identification of difficulties before they exacerbate.

Limitations. Our convenience sample of 157 participants demonstrates the margin of error of 8.3% at a 95% confidence interval and the observed proportion of 50%. While the margin of error for any survey should be less than 5%, our research should be counted only as a pilot study. For stress/anxiety surveys, under-reporting and over-reporting bias cannot be fully excluded. We were unable to include a control group (for example, general nursing students) because we did not have an approval from the Ethics Committee.

Conclusion. The radiologic science students in this study reported an overall positive emotional well-being. Educators should be aware of students' educational obstacles, including the influence of nonacademic stressors, and advocate for resources to improve student emotional well-being. Helping students maintain high levels of emotional health is beneficial for their education. Future research on the development and effectiveness of stress management interventions among radiologic science students is warranted.

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