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Determination of the Knowledge Level of Medical Faculty Students About Radiation Used in Medical Diagnosis and Treatment

Tıp Fakültesi Öğrencilerinin Tıbbi Tanı ve Tedavide Kullanılan Radyasyon Hakkındaki Bilgi Düzeylerinin Belirlenmesi

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ÖZ

Amaç: Bu çalışmada, sağlık hizmetlerinin çeşitli kademelerinde çalışacak tıp fakültesi öğrencilerinin tıbbi tanı ve tedavide kullanılan radyasyon hakkındaki farkındalık ve bilgi düzeylerinin belirlenmesi amaçlanmıştır.
Araçlar ve Yöntem: Bu tanımlayıcı çalışmada, veriler tıp fakültesi öğrencilerinin anket sorularını elektronik ortamda yanıtlamasıyla elde edilmiştir. Anket formu, katılımcıların demografik özelliklerini, radyasyon hakkındaki eğitim durumlarını ve radyasyon kullanımı hakkındaki farkındalıklarını belirlemek için 7 sorudan ve tanı ve tedavide kullanılan radyasyon hakkındaki bilgi düzeylerini belirlemek için 23 sorudan oluşmaktadır. Verilerin değerlendirilmesinde tanımlayıcı istatistiksel yöntemler ve Shapiro-Wilk, Kruskal-Wallis ve Mann Whitney U testleri kullanılmıştır.
Bulgular: Çalışmaya 305 kişi katılmış ve çalışmaya katılması onaylanan kişi sayısı 299 olmuştur. En yüksek ortalama ikinci sınıf öğrencileri için 13.48±3.13'tür. İkinci, üçüncü ve dördüncü sınıf öğrencilerinin puan ortalamaları arasında istatistiksel olarak anlamlı bir fark olduğu belirlenirken, diğer sınıfların ortalamaları ile anlamlı bir fark olmadığı tespit edilmiştir ($p<0.05$, $p<0.001$, $p>0.05$).
Sonuç: Araştırma sonucuna göre, sağlık hizmetlerinin çeşitli alanlarında çalışacak hekim adaylarına tıp fakültelerinde dikey entegrasyon ile özellikle son sınıfta tıbbi tanı ve tedavide kullanılan radyasyona yönelik yenileme eğitimine ihtiyaçları olduğu, hekimlerin mesleki yaşamlarında kendilerine ve hastalara yönelik radyasyon risklerine karşı daha duyarlı olmaları gerektiği söylenebilir.

Anahtar Kelimeler: hekimler; radyasyon tedavisi; radyasyonun biyolojik etkileri; tanısal radyasyon; tıp eğitimi

ABSTRACT

Purpose: This study aimed to determine the awareness and knowledge levels of medical faculty students who will work at various levels of health care about radiation used in medical diagnosis and treatment.
Materials and Methods: In this descriptive study, data were obtained by medical faculty students answering survey questions electronically. The survey form consisted of 7 questions to determine the demographic characteristics of the participants, their education status about radiation, and their awareness about the use of radiation, and 23 questions to determine their level of knowledge about radiation used in diagnosis and treatment. Descriptive statistical methods and Shapiro-Wilk, Kruskal-Wallis and Mann Whitney U tests were used to evaluate the data.
Results: The study was accessed by 305 people and 299 people approved to participate in the study. The highest average was 13.48±3.13 for second-year students. It was determined that there was a statistically significant difference between the mean scores of second-year students, third-year students, and fourth-year students, while it was found that there was no significant difference with the means of other classes ($p<0.05$, $p<0.001$, $p>0.05$).
Conclusion: According to the results of the research, it can be said that physician candidates who will work in various areas of health services need vertical integration in medical schools and refresher training on radiation used in medical diagnosis and treatment, especially in the final year, and that physicians should be more sensitive to radiation risks to themselves and patients in their professional lives.

Keywords: biological effects of radiation; diagnostic radiation; medical education; physicians; radiation therapy

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INTRODUCTION

Radiation, which in its most basic definition is expressed as energy emitted in the form of waves or energetic particles, is an integral part of our environment. Today, radiation has widespread use, from the defense industry to energy production, from agriculture to medical applications.[1,2] Depending on the effect it creates in its interaction with matter, radiation is divided into two: ionizing and non-ionizing. Alpha and beta particles and X and gamma rays are types of ionizing radiation. On the other hand, radio waves, infrared rays, visible light and ultraviolet are non-ionizing types of radiation.[3,4] The biological effects of ionizing radiation are divided into two parts: deterministic and stochastic. Deterministic effects occur above a threshold dose, and the severity and incidence of effects subsequently increase as a function of the radiation dose exposed. Hematopoietic, gastrointestinal, and central nervous (CNS) syndromes are deterministic effects after ionizing radiation exposure.[5-8] Effects of ionizing radiation such as genetic mutation and cancer are expressed as stochastic effects. Stochastic effect refers to probabilistic effects that occur by chance, regardless of any threshold dose.[9,10] Cancer is a genetic disease caused by changes that occur as a result of an error or damage in DNA. On the other hand, exposure to external influences may lead to the development of abnormal cell growth events in the human body and, as a result, the formation of cancer. It is estimated that 90% of cancer in humans is caused by chemicals, 5% by viruses and 5% by radiation.[10-13]

We are exposed to radiation throughout our lives due to natural and artificial radiation sources. While approximately 15% of the public's exposure to ionizing radiation originates from artificial sources, the increasing use of radiation in diagnosis and treatment in medicine with the development of technology accounts for almost all of this rate. Computed tomography (CT),radiography (X-ray), angiography, bone densitometry (DEXA), mammography, nuclear medicine examinations and radiotherapy are the most common areas of use of ionizing radiation in diagnosis and treatment in medicine. On the other hand, magnetic resonance imaging (MRI), ultrasound and radiofrequency treatment applications constitute the areas of use of non-ionizing radiation in diagnosis and treatment.[12,14]

According to the report of the Organization for Economic Co-operation and Development, Türkiye is among the leading countries in the utilization of radiological imaging procedure. This situation also increases exposure to medical radiation. It can be said that physicians lack of knowledge about the radiation dose and effects of radiology procedures used in medical diagnosis and treatment, their concern about legal problems, and the intense demand for radiological examinations from patients are effective in the high demand for radiological examinations.[15,16]

This study aims to determine the awareness and knowledge levels of medical faculty students who are trained to work at various levels of health services about radiation used in medical diagnosis and treatment.

MATERIALS and METHODS

This study is a descriptive type research. The study data was obtained by students studying at Kırşehir Ahi Evran University faculty of medicine, answering the survey questions prepared by literature review electronically (Google forms) between May 2024 and June 2024. The created survey form consists of a first part of 7 questions to determine the demographic characteristics of the participants, their education about radiation and their awareness about the use of radiation. The second part consists of 23 questions with the options “True”, “False” and “No Idea” to determine the participants knowledge level about radiation used in diagnosis and treatment. Knowledge level scores were calculated by giving 1 point to correct answers and 0 points to questions with incorrect answers and the “no idea” option. Participants gave informed consent and answered the study questions without any time limits. This study was approved by Kırşehir Ahi Evran University Faculty of Medicine, Health Sciences Scientific Research Ethics Committee (dated 30/04/2024 and numbered 2024-09/74).

The population of this research consists of 762 students registered at Kırşehir Ahi Evran University Faculty of Medicine as of the date of the study. In the research, stratified sampling method was used to ensure that all students were represented in the sample. EpiInfo 7.2 for sample calcula-

tion program was used. The sample of the study was calculated as 255 people with a prevalence of 50%, margin of error of 5%, pattern effect of 1, and confidence level of 95% (Table 1).

Table 1. Study sample determined by stratified sampling method.

Variables	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade	Total
Population	215	176	132	93	68	78	762
Stratified sample (%95)	72	59	44	32	22	26	255

Statistical Analysis

The study data, which was conducted with the participation of Kırşehir Ahi Evran University Faculty of Medicine students, was recorded via Google Form. Data analysis was performed using the Graphad Prism 9 package program. Descriptive statistical methods such as arithmetic mean, standard deviation, maximum, minimum, frequency and percentage were used in the evaluation of the collected data. The Shapiro-Wilk test was used to examine the conformity of the data to normal distribution. Kruskal-Wallis and Mann Whitney U tests were used in the comparison of the groups. The statistical significance level was accepted as $p<0.05$. Cronbach Alpha value (0.872) was found to be reliable at a good level to determine the consistency between the items with SPSS 29 statistical package program.

RESULTS

The survey form was accessed by 305 students of Kırşehir Ahi Evran University Faculty of Medicine, and 299 people gave their consent to participate in the study. The distribution of approved students according to classes was as follows; 28.09% was 1st grade, 23.08% was 2nd grade, 18.39% was 3rd grade, 11.71% was 4th grade, 10.03% was 5th grade and 8.70% was 6th grade.

While 42.47% of the participants stated that they received training on radiation and radiation protection, it was stated that the place of education was university education (Table 2). "*As physician candidates who will work at different levels of healthcare, how would you describe your level of knowledge about the types and doses of radiation used in medical diagnosis and treatment*?" 7.69% of the students answered the question as "I don't know", 4.68% as "Good", 41.47% as "Low" and 46.15% as "İntermediate" (Table2). In addition, 81.61% of the students thought it was completely important and 16.05% thought it was partly important to have knowledge about radiation used in medical diagnosis and treatment, while only 2.34% did not think it was important (Table 2).

It is known that exposure to radiation during infancy and childhood increases the likelihood of developing different types of cancer in later periods. Therefore, it is important to reveal doctor awareness of individuals sensitivity to radiation exposure at different periods. The answers of the doctor of medicine candidates participating in our study to the question on this subject were as follows; 87.63% said that the most sensitive group to radiation was infants and children, 7.02% said they did not know, 3.01% said adults, and 2.34% said the elderly (Table 2). On the other hand, it is important to use safe imaging methods during pregnancy for the health of both the mother and the fetus. In this context, 94.98% of the students answered magnetic resonance imaging, 44.82% ultrasound and 6.35% angiography as radiological procedures that can be safely applied during pregnancy. On the other hand, 5.35% of the students answered mammography, 4.35% radiography and 2.01% computed tomography, while the answers radiotherapy and positron emission tomography were 1% and 0.67%, respectively. In addition, students answered questions about radiation dose values for some radiography methods. 9.7% of the students answered correctly the approximate effective dose in anthropo-posterior chest radiography and 17.73% in abdomen and pelvis computed tomography examination.

Table 2. Distributions of participants' responses regarding their education status, self-assessment and radiation exposure regarding radiation used in medical diagnosis and treatment.

Variables	Number (n)	Percantage (%)
Educational Status		
Yes	127	42.47
No	172	57.53
Knowledge level states defined by participants		
I don't know	23	7.69
I have a good level of knowledge	14	4.68
I have a low level of knowledge	124	41.47
I have intermediate knowledge	138	46.15
Topic importance level according to participants		
I think it's totally important	244	81.61
I think it is partly important	48	16.05
I don't think it matters	7	2.34
The groups most sensitive to radiation		
Babies and children	262	87.63
I don't know	21	7.02
Adults	9	3.01
Senior citizens	7	2.34
Which radiological procedure can be used safely in diagnosis and treatment during pregnancy?		
Ultrasound (USG)	284	94.98
Magnetic Resonance Imaging (MRI)	134	44.82
Angiography	19	6.35
Mammography	16	5.35
Radiography	13	4.35
Computed Tomography (CT)	6	2.01
Radiotherapy	3	1.00
Positron Emission Tomography (PET)	2	0.67

Of the 23 questions asked to determine the knowledge level of the participants, the rate of those who answered 12 or fewer questions correctly was 69.23%, while the rate of those who answered 13-18 questions correctly was 28.43% (Table 3). Only 2.34% of the students answered 19 or more questions correctly (Table 3). The highest median value was found for the 2nd graders, while the lowest median value was found for the 1st graders with 7. The 1st grade students who participated in the study answered a maximum of 15 questions correctly. On the other hand, it was determined that a maximum of 19 questions were answered correctly in the 2nd and 3rd grades. For all other grades, only a maximum of 17 questions were answered correctly. While 94.05% of first-year students answered 12 or fewer questions correctly, 49.28% of second-year students answered 13-18 questions correctly. In addition, 8.70% of the second grade students answered 19 questions and above correctly. When we look at all grades, more than half of the students in all grades except 2nd grades answered only 12 or fewer questions correctly (Table 3).

Table 3. Descriptive data of groups.

Variables	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade	Total
Number of values	84	69	55	35	30	26	299
25% Percentile	5.00	11.00	9.00	6.00	9.00	9.75	
Median	7.00	13.00	10.00	9.00	12.00	12.00	
75% Percentile	9.00	16.00	14.00	12.00	13.00	14.00	
Maximum	15.00	19.00	19.00	17.00	17.00	17.00	
Mean	7.39	13.48	11.16	8.97	10.97	11.81	
Std. Deviation	3.01	3.13	3.48	4.23	3.50	2.87	
Std. Error of Mean	0.33	0.38	0.47	0.71	0.64	0.56	
Answered 12 or less questions correctly (%)	94.05	42.03	67.27	77.14	66.67	57.69	69.23
Answered 13 - 18 questions correctly (%)	5.95	49.28	30.91	22.86	33.33	42.31	28.43
Answered 19 or more questions correctly (%)	0.00	8.70	1.82	0.00	0.00	0.00	2.34

Knowledge level scores about radiation used in medical diagnosis and treatment were calculated for all classes participating in the study. The average score of 1st grade students was found to be 7.39±3.0 and the lowest average score belonged to this group. The highest average was the average of the scores of 2nd grade students, with 13.48±3.13. The average score calculated from the answers given by 3rd grade students was determined as 11.16±3.48. The mean scores of the 4th and 5th grades were found to be 8.97±4.23, 10.97±3.5, respectively and

the average score of the 4th grades was determined as the second lowest. The mean score of the 6th graders was 11.81±2.87 and it was the group with the highest score after the 2nd grades.(Table 3). The average score of the 2nd, 3rd, 5th and 6th grades was higher than the average knowledge score of the 1st grades, and the difference between these groups was determined to be statistically significant ($p<0.001$). On the other hand, it was observed that there was no statistically significant difference between 4th graders and 1st graders ($p>0.05$). The 2nd Graders had the highest average score and it was determined that there was a statistically significant difference between the 3rd and 4th Grades' average scores ($p<0.05$, $p<0.001$). In addition, it was found that there was no statistically significant difference between all other groups ($p>0.05$)(Figure 1).

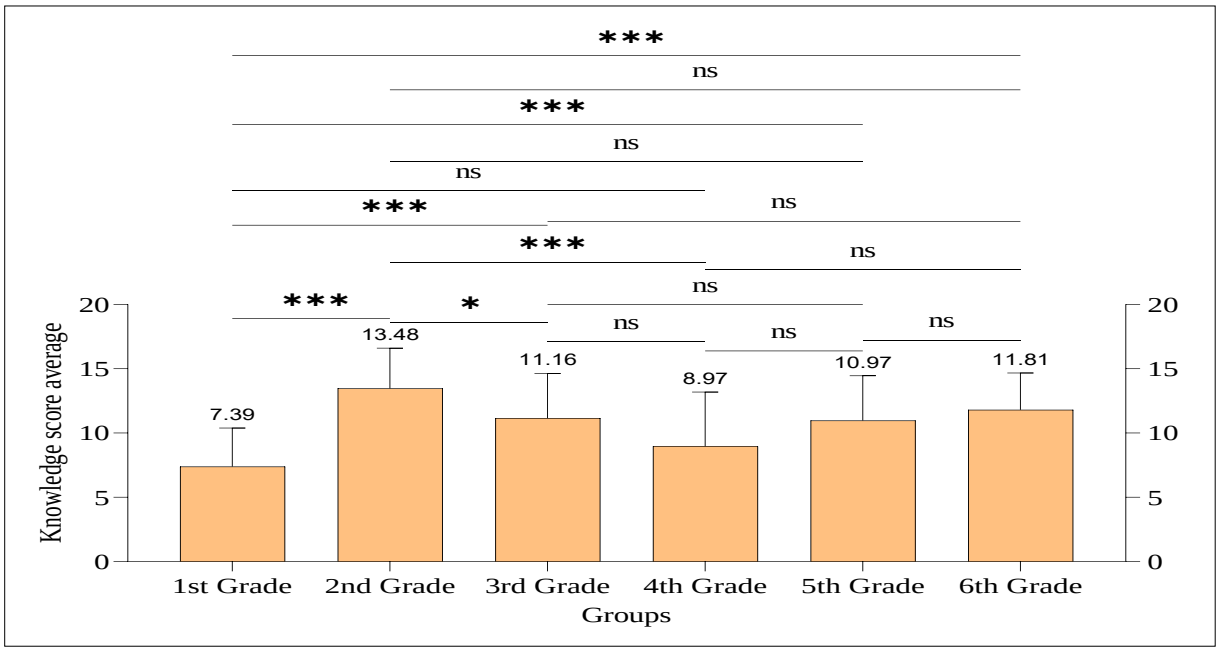

Figure 1. Comparing the knowledge score averages of the groups. Statistical data ns: not significant, *p < 0.05 and ***p < 0.001.

The average scores of the students participating in the study according to their education about radiation and radiation protection are given in Figure 2a. The average score of the students who declared that they received training was 12.31±3.48, while the average score of the students who stated that they did not receive training was 9.02±3.82 and the difference between these two groups was determined to be statistically significant ($p<0.0001$). The participants' self-defined knowledge levels about radiation used in medical diagnosis and treatment and their average scores are presented in Figure 2b. The average score of those who defined their knowledge level as "Good level" was 13.07±3.05, while the average score of those who defined their knowledge level as "Low level" was 9.39±3.71.It was observed that the knowledge level defined by the participants and the average scores they received were compatible. In addition, while there was no statistically significant difference between the mean scores of those who defined their knowledge level as "Good level" and "İntermediate level", the difference between the other groups was found to be significant ($p<0.05$, $p<0.01$, $p<0.0001$).

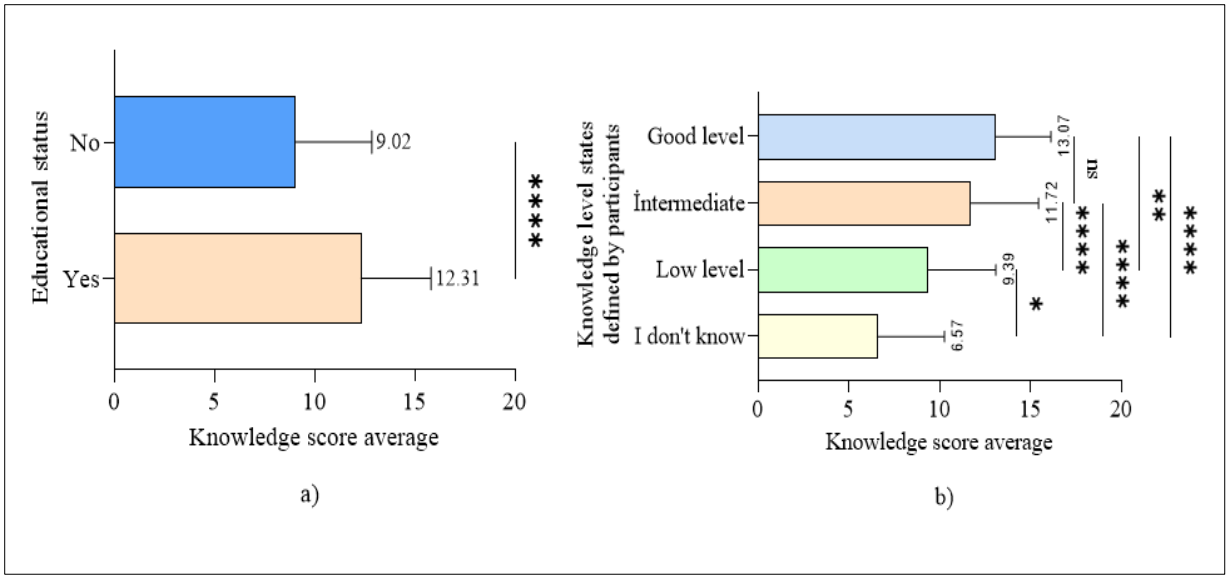

Figure 2. Comparison of participant's educational status (a) and their defined knowledge levels (b) according to their knowledge level scores. Statistical data ns: not significant, *p < 0.05, **p < 0.01 and ****p < 0.0001.

DISCUSSION

In our study, 42.47% of the participants declared that they had received training on radiation and radioprotection, while in the study conducted with physicians at the Suez Canal University Hospital, it was stated that 88% of the participants had not received any training on radiation safety and that the knowledge levels of radiologists and oncologists, who are exposed to more radiation than other branches, are as low as those of surgeons and orthopedists.[17] In another study conducted to determine the knowledge levels of 4th, 5th and 6th year medical faculty students and about ionizing radiation, it was stated that 17.9% of the students and 18.6% of the residents had sufficient knowledge.[18] In our study, 77.14% and 66.67% of the 4th and 5th grade students, respectively, answered 12 or fewer questions about their knowledge level correctly. 42.31% of the 6th grade students who participated in the study answered 13-18 questions correctly.In another study conducted by Arslanoğlu et al., they stated that most doctors and interns do not have sufficient awareness and knowledge about radiation protection and that radiation is underestimated and they emphasized their suggestions to eliminate this deficiency.[19] In another study conducted with general practitioners and specialist physicians, 54% of general practitioners and 25% of specialist physicians stated that they were not informed about the risks of radiation exposure.[20] In our study, only 31.44% of the participants correctly answered the questions about radiation-resistant/sensitive cells and the biological effects of radiation. In another study conducted with senior dentistry students and dentistry specialist students, researchers determined that nearly half of these two groups did not have sufficient knowledge about the deterministic and cytotoxic effects of radiation. The researchers emphasized that the biological effects of radiation should be emphasized more throughout dentistry education and that refresher training should be provided for specialist students.[21] In the study conducted by Zakeri et al., it was reported that only 33% of physicians knew the chest X-ray dose exposure and 31% knew the approximate doses of various procedures according to chest X-ray.[20] In our study, only 9.7% of the physician candidates correctly answered the approximate effective dose value in the anthropo-posterior chest radiograph. In addition, 17.73% of the participants correctly answered the approximate effective dose value in the Abdomen and Pelvis computed tomography (CT) examination. In a study conducted with fourth-year medical students, the students answered survey questions about ionizing radiation and radiation protection before and after the training, and the researchers reported a 31% increase in the students knowledge levels after the training.[22] In the study conducted with medical students by Çakmak et al., the students answered correctly the radiation content in Computed Tomography, Mammography and Radiography at the rates of 83.1%, 66.3% and 96.4%, respectively.[23] In our study, 25.08% of the participants answered correctly that

non-ionizing radiation is not used in X-rays, and 48.83% answered correctly that ionizing radiation is not used in MRI. 71.57% of the physician candidates who participated in the study answered correctly that X-rays are not used in USG, and 50.17% answered correctly that X-rays are used in Mammography. In another study conducted by Koçyiğit et al. on the radiation dose to which patients are exposed during radiological imaging methods with hospital staff, nurses, medical students and research assistants, they reported that 38% of the participants thought that MRI contained radiation. The researchers drew attention to the low level of knowledge about ionizing radiation.[24]

Conclusion

The effects of ionizing and non-ionizing radiation on human health are clearly stated by studies conducted in the last century. Radiation causes biological effects by changing intracellular molecular mechanisms. However, the carcinogenic effect of radiation is obvious with all the evidence.[25] Therefore, determining the knowledge level of physician candidates who will work in various stages of health care about the types, doses and biological effects of radiation used in medical diagnosis and treatment is important in terms of minimizing the risks of individuals forming the society due to medical radiation exposure. In our study conducted with students of Kırşehir Ahi Evran University Faculty of Medicine, it was observed that the students knowledge level about radiation used in medical diagnosis and treatment increased during the year of their education, but this knowledge level tended to decrease in the senior years. We believe that it would be appropriate to provide refresher training on radiation used in medical diagnosis and treatment, especially in the final year, with vertical integration in medical faculties.

Conflict of Interest

The authors declare that there is not any conflict of interest regarding the publication of this manuscript.

Ethics Committee Permission

This study was approved by Kırşehir Ahi Evran University Faculty of Medicine, Health Sciences Scientific Research Ethics Committee (dated 30/04/2024 and numbered 2024-09/74).

Authors' Contributions

Concept/Design: GG. Data Collection and/or Processing: GG. Data analysis and interpretation: GG. Literature Search: GG. Drafting manuscript: GG. Critical revision of manuscript: GG. Supervison: GG.

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