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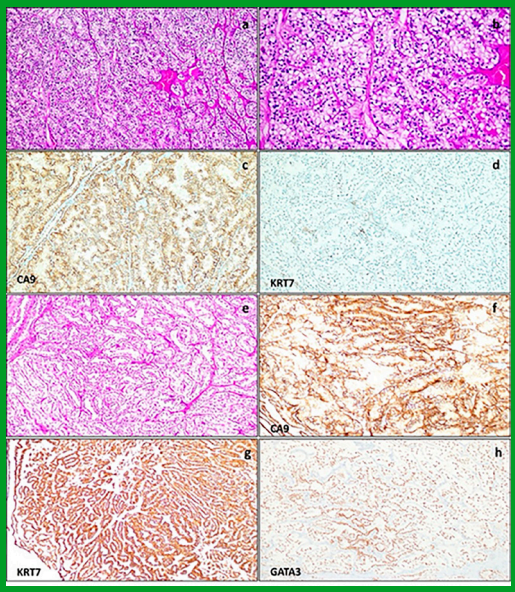

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Original Articles

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EDITORIAL

Dear Readers;

We are delighted to be with you again in the final issue of 2025.

Bezmialem Science is the multidisciplinary journal of Bezmialem Vakıf University in the field of health. Bezmialem Vakıf University derives its name and stance from Bezmialem Valide Sultan's foundation tradition of combining science and compassion. This legacy allows us to carry historical traces into today's scientific advancements.

In this issue, we chose our cover image from the article by Yaprak Bayrak B and Akgul M, titled "Immunohistochemical Diagnostic Algorithm for Renal Cell Carcinoma with Fibromyomatous Stroma." The article, which describes the immunohistochemical diagnostic algorithm for renal cell carcinoma with fibromyomatous stroma, emphasizes the need for a stepwise algorithmic approach, incorporating emerging immunophenotypic markers alongside the currently widely used and conventional markers in this field. We wanted to reiterate the importance of algorithms while sharing this concise yet significant proposal with you.

Other articles selected for the cover are:

"Traditional, Complementary and Alternative Medicine Studies in Oncology: A Web of Science-based Bibliometric Network Analysis (2020-2024)" by Akalın B et al.

"Effects of *Momordica charantia* on Gastritis" by Iskurt Y et al.

"The Glasgow Prognostic Score (GPS) May Serve as a Prognostic Indicator in ST-Elevation Myocardial Infarction (STEMI) Patients Undergoing Emergency Coronary Artery Bypass Graft Surgery" by Uzun N et al.

In our journal, we believe that knowledge should be evaluated not only by citation metrics, but also by its impact on patient outcomes and policy and guidelines. Therefore, we seek the triad of methodological soundness, clinical relevance, and societal benefit in every article. This requires a great deal of effort.

I would like to thank our new assistant editor, section editors, and reviewers for their hard work and contributions, as well as their intense work schedules. Each of their contributions is invaluable to us.

We plan to move one step closer to our goals with the new issues we will publish in the new year with your contributions. I take this opportunity to wish you, our valued readers, and the Bezmialem Science family a happy new year.

I wish you all the best…

Sincerely,

Prof. Dr. Adem AKÇAKAYA
Editor-in-Chief

Original Article

DOI: 10.14235/bas.galenos.2025.29964
Bezmialem Science 2025;13(4):274-280

Treatment Adherence in Schizophrenia and Other Psychotic Disorders: A Cross-sectional Study of Treatment Collaboration Portal-registered vs. Non-registered Patients

Tedavi İş Birliği Portalı'na Kayıtlı Olan ve Olmayan Şizofreni ve Diğer Psikotik Bozukluk Tanılı Hastaların Tedavi Uyumunun Karşılaştırılması - Kesitsel Bir Çalışma

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ABSTRACT

Objective: This study aimed to compare medication adherence and hospitalization rates before and after enrollment in the treatment collaboration program (TCP) among patients with schizophrenia and other psychotic disorders at the community mental health center, between those registered in the TCP and those who were not.

Methods: The sample was divided into two groups those registered and those not registered in the TCP. Socio-demographic data and questionnaire forms, Positive and Negative Syndrome Scale (PANSS), Personal and Social Performance Scale (PSP), and Medication Adherence Rating Scale (MARS) were administered to the groups. Additionally, hospitalization rates and types (voluntary-involuntary) before and after enrollment were examined for patients registered in the TCP.

Results: The study included a total of 107 patients, with 75 registered in the TCP and 32 not registered. The group of patients

ÖZ

Amaç: Şizofreni ve diğer psikotik bozukluk tanıları ile Toplum Ruh Sağlığı Merkezi'nde (TRSM) takipli hastalardan Tedavi İş birliği Portalı'na (TİP) kayıtlı olan ve olmayanların tedavi uyumları ile TİP'e kayıt öncesi ve sonrası yatarak tedavi oranlarının karşılaştırılması planlanmıştır.

Yöntemler: Örneklem; TİP'e kayıtlı olan ve olmayan olarak iki gruba ayrılmıştır. Gruplara sosyodemografik veri ve anket formu, Pozitif ve Negatif Sendrom Ölçeği (PNSÖ), Bireysel ve Sosyal Performans Ölçeği (BSPÖ) ve Tıbbi Tedaviye Uyum Oranı Ölçeği (TTUOÖ) uygulanmıştır. Ayrıca TİP'e kayıtlı hastaların kayıt öncesi ve sonrası yatış sayıları ve yatış şekilleri (istemli-istemsiz) incelenmiştir.

Bulgular: Çalışmaya, TİP'e kayıtlı 75, TİP'e kayıtlı olmayan 32 olmak üzere toplam 107 hasta alınmıştır. TİP'e kayıtlı olan hasta grubunda erkek cinsiyet daha fazla saptanmıştır. İki grup arasında BSPÖ, TTUOÖ, PNSÖ toplam puan ve alt ölçek puanları

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ABSTRACT

registered in the TCP consisted predominantly of males. There was no significant difference between the two groups in terms of PSP, MARS, PANSS total scores, and subscale scores. In comparing hospitalization rates, a statistically significant decrease was found in the post-registration hospitalization rate of TCP-registered patients ($p<0.05$). A Standard Multiple Regression analysis for PSP score revealed that gender, time until treatment, and PANSS subscale scores explained 37% of the total variance.

Conclusion: While we did not find any immediate association between TCP and factors such as symptom severity or medication adherence, it could be suggested that TCP had a positive contribution in reducing hospitalization rates in the long term.

Keywords: Community mental health center, schizophrenia, psychotic disorders, treatment collaboration program, medication adherence

ÖZ

açısından anlamlı bir fark bulunmamıştır. Yatış sayısında yapılan karşılaştırmada TİP'e kayıt sonrası hastaların yatış oranında istatistiksel olarak anlamlı bir azalma olduğu tespit edilmiştir ($p<0,05$). BSPÖ puanı için yapılan Standart Çoklu Regresyon analizinde; cinsiyet, tedaviye kadar geçen süre ve PNSÖ alt ölçek puanlarının toplam varyansın %37'sini açıkladığı bulunmuştur.

Sonuç: TİP'in, kısa vadede hastalık belirti şiddeti veya ilaç uyumu gibi durumlarla ilişkisini tespit etmemiş olsak da uzun vadede hastaneye yatış oranında azalma şeklinde olumlu katkısı olduğu söylenebilir.

Anahtar Kelimeler: Toplum ruh sağlığı merkezi, şizofreni, psikotik bozukluklar, tedavi iş birliği portalı, tedavi uyumu

Introduction

Schizophrenia and other psychotic disorders are chronic and progressive conditions characterized by various clinical presentations, relapsing courses, and frequent hospitalizations (1,2). Pharmacotherapies alongside psychoeducation are the first-line treatment options for these disorders. Therefore, adherence to medication is highly important (3,4); however, serious difficulties regarding treatment adherence are frequently encountered in this patient group (2). Multiple factors, such as younger age, male gender, lack of insight, illness severity, low socioeconomic status, and comorbid alcohol or substance use negatively affect treatment adherence (2). Non-adherence in these patients leads to increased hospitalization, morbidity, and mortality, consequently reducing the patient's quality of life (5). For all these reasons, improving treatment adherence is crucial not only for the patient but also for their relatives, the broader society, and the healthcare system (6). Treatment adherence refers not only to the patient's use of psychopharmacological agents but also to compliance with regular follow-ups and behavioral recommendations, encompassing all aspects of treatment (7). Due to the challenges associated with adherence, desired clinical outcomes often cannot be achieved, prompting the search for alternative approaches. Accordingly, the World Health Organization has recommended a community-based mental health model (8). In community mental health centers (CMHCs), established to provide psychosocial support to individuals with severe mental disorders such as schizophrenia, bipolar disorder, and other psychotic conditions, specialized treatments are administered alongside pharmacotherapy to maintain well-being. This model aims to ensure continuity of care within the community and to reduce hospitalization. Several studies have shown decreased hospitalization rates in patients regularly followed up in CMHCs (9-11). In CMHCs, patients' follow-up appointments are monitored, psychoeducation is provided to patients and their families, and skill training is offered to patients (12). Therefore, in order for the programs implemented in CMHCs to be recommended and applied as part of treatment, they must be evidence-based (13).

Another system specifically developed for Türkiye to support treatment adherence in patients diagnosed with schizophrenia and other psychotic disorders is the treatment collaboration portal (TCP). This system has been used by CMHCs since 2010, following approval by the Ministry of Health. It is a web-based (IVR) system used to remind relatives of patients monitored by CMHCs after obtaining written informed consent-about the patients' appointments, medical tests, activities, and injection schedules. Participants in the program are assigned a file number by the CMHC treatment team in order to maintain anonymity, and no personal data, including health information, is entered into the system. By entering patient information into the portal, the treatment team ensures that reminders related to appointments, injections, therapy sessions, family education, and blood tests are sent via the voice response system to the mobile phones of either the patient or their caregiver. The aim of the TCP is to increase adherence to medication and rehabilitation services, and to facilitate the active engagement of both patients and their families in monitoring and participating in the treatment process.

In the literature, there are studies focusing on weekly group therapies, post-discharge telephone-based symptom monitoring, and telehealth applications in relation to disease course, treatment adherence, and hospitalization rates (3-6); however, no program or study comparable to the TCP-which is not limited solely to the post-discharge period and has a broader scope-has been identified (14-17). Currently, TCP is not implemented in all CMHCs across our country. Although its use is becoming increasingly widespread, we aimed to evaluate, in an evidence-based manner, the benefits and impacts of the system as one of the few centers actively using it. To this end, the study was conducted to compare medication adherence and hospitalization rates before and after registration in TCP among individuals diagnosed with schizophrenia and other psychotic disorders who were being followed in a CMHC, based on whether they were registered in the TCP program or not.

Methods

Participants

This study included individuals aged 18-65 who presented to the Psychotic Disorders Outpatient Clinic of Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital between 01.02.2021 and 01.02.2022, were literate, provided written informed consent to participate, and were clinically stable. Clinical stability was defined as scoring 3 or less on the following items of the Positive and Negative Syndrome Scale (PANSS): P1, P2, P3, N1, N4, N6, G5, and G9. Participants were diagnosed with schizophrenia, schizoaffective disorder, or delusional disorder. Individuals with organic mental disorders, such as dementia or intellectual disability, were excluded from the study.

Participants were grouped based on whether they were registered in the TCP. To evaluate the effect of appointment and treatment reminders via TCP, only those who had been registered in the system for at least six months were included; patients with shorter registration durations were excluded. Each participant was assessed once using a sociodemographic data and questionnaire form, the PANSS, the Personal and Social Performance Scale (PSP), and the Medication Adherence Rating Scale (MARS). Additionally, for TCP-registered patients, the number and type (voluntary/involuntary) of hospitalizations before and after portal registration were examined.

All participants signed an Informed Consent Form and were informed about the study's purpose and procedures. The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Clinical Research Ethics Committee of Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital on 27.01.2021 with decision number 2021-01/985.

Data Collection Tools

Sociodemographic and Clinical Data Form: This form was developed by researchers to obtain information about the sociodemographic and clinical characteristics of the study participants.

Positive and Negative Syndrome Scale (PANSS): The scale was developed by Kay et al. (18) in 1987. It consists of 30 items and includes three subscales: "Positive Symptoms", "Negative Symptoms", and "General Psychopathology". Items are rated on a 7-point Likert scale. The Turkish validity and reliability study of the scale was conducted by Kostakoglu et al. (19) in 1999. The Cronbach's alpha coefficients for the subscales range from 0.73 to 0.83.

Personal and Social Performance Scale (PSP): Developed by Morosini et al. (20) in 2000, this scale includes four dimensions evaluated by the interviewer: "socially useful activities", "personal and social relationships", "self-care", and "disturbing and aggressive behaviors". Items are scored using a 6-point Likert scale, and a total score between 0 and 100 is calculated based on a reference scoring chart. The Turkish validity and reliability study of the scale was conducted by Aydemir et al. (21) in 2009. Cronbach's alpha internal consistency coefficient was calculated as 0.8327.

Medication Adherence Rating Scale (MARS): This scale was developed by Thompson et al. (22) in 2000, and the Turkish validity and reliability study was conducted by Koç (23) in 2006. The scale consists of 10 yes/no questions. Higher scores indicate better treatment adherence. Items seven and eight are reverse-coded. MARS scores are classified as follows: 10= full adherence; 9-7= partial adherence; 5-6= poor adherence; <5= non-adherence (24). The Cronbach's alpha internal consistency coefficient was found to be 0.92.

Statistical Analysis

The data obtained from the participants were statistically analyzed using version 25 of SPSS. In descriptive statistics, continuous variables were expressed as mean ± standard deviation and minimum-maximum (min-max) values, while categorical variables were presented as frequencies and percentages. The normality of distribution for the variables was assessed using the Kolmogorov-Smirnov test. For comparisons between groups, the t-test was used for normally distributed data, and the Mann-Whitney U test was used for non-normally distributed data. For comparisons of categorical variables between groups, the chi-square test was applied. To examine the relationships between continuous variables, Pearson correlation was used for normally distributed data, and Spearman correlation was used for non-normally distributed data. To assess whether there was a significant difference in the number of hospitalizations before and after registration among TCP-registered among registered patients, the Wilcoxon signed-rank test was applied. Finally, standard multiple regression analysis was conducted to evaluate the factors predicting medication adherence and individual/social performance.

Results

A total of 107 patients were included in the study, comprising 75 patients registered in the TCP and 32 patients who were not registered. Among 163 patients who presented to the psychotic disorders outpatient clinic within one year, 56 were excluded from the study due to coexisting intellectual disability, inability to complete the forms due to active symptoms, recent hospitalization within the last three months, not being in remission, or unwillingness to participate.

The sociodemographic and clinical characteristics of the groups are presented in Table 1. The mean age of the TCP-registered group was 45.7±10.8 years (min-max: 25-71), while the mean age of the non-registered group was 46.06±12.7 years (min-max: 23-70). Among all participants, 106 (99.1%) were diagnosed with schizophrenia, and 1 (0.9%) was diagnosed with schizoaffective disorder. No statistically significant differences were found between the two groups in terms of age, illness duration, employment status, educational level, or marital status. However, a statistically significant difference was found between the groups regarding gender ($p<0.05$). The proportion of male

patients was higher in the TCP-registered group compared to the non-registered group.

There were no statistically significant differences between the two groups in PSP, MARS, or PANSS total and subscale scores (Table 2).

In the TCP-registered patient group, hospitalization rates were calculated over specific index periods to examine whether the number of hospitalizations changed following registration. Two variables were created: the "pre-registration hospitalization rate", calculated by dividing the number of hospitalizations before registration by the duration of illness prior to registration; and the "post-registration hospitalization rate", calculated by dividing the number of hospitalizations after registration by the duration of time the patient had been registered in TCP. A comparison of hospitalization rates revealed a statistically significant decrease in hospitalization following TCP registration ($p<0.05$).

To evaluate the factors predicting individual and social performance, a standard multiple regression analysis was conducted (Table 3). The independent variables included gender, duration until initiation of treatment, and the subscale scores for positive symptoms, negative symptoms, and general psychopathology from the PANSS. The model was found to explain 37% of the total variance [$R^2=0.37$, $F(5)=11.8$, $p<0.05$]. The variable contributing most to the model was the PANSS negative symptom subscale ($\beta=0.516$), followed by the PANSS positive symptom subscale score ($\beta=0.271$) ($p<0.05$).

A separate model was created to examine the factors predicting medication adherence. In this model, gender, duration until initiation of treatment, and PANSS subscale scores for positive symptoms, negative symptoms, and general psychopathology were included as independent variables. This standard multiple regression analysis was not statistically significant.

Discussion

In this study, the effectiveness of the TCP program, which aims to improve treatment adherence in patients with schizophrenia and other psychotic disorders, was investigated. Patients registered in TCP-a web-based system used to help patients and their families monitor treatment and improve adherence to pharmacological therapy were compared with non-registered patients in terms of medication adherence, individual and social performance, and symptom severity. Based on our analyses, no statistically significant differences were found between the two groups in PSP, MARS, or PANSS total and subscale scores. Within the sample, positive and negative symptom severity emerged as factors influencing individual and social performance.

A higher proportion of male patients was observed in the TCP-registered group. Previous studies on treatment adherence have reported that non-adherence is more common among male patients (25,26). One of the primary aims at our center was to enroll patients with a history of non-adherence in the system to monitor and support their treatment regimen.

Table 1. Sociodemographic and clinical characteristics of patients in both groups

		TCP-registered patients		Non-registered patients		
Variables		**n**	**%**	**n**	**%**	**p-value**
Gender	Male	52	69.3	14	43.8	**0.017***
	Female	23	30.7	18	56.3	
Educational level	Primary or below	24	32	13	40.7	0.428
	High school	20	41.3	9	28	
	University or higher	20	26.7	10	31.3	
Employment status	Unemployed	36	48	13	40.6	0.530
	Employed	39	52	19	59.4	
Marital status	Single	53	70.7	20	62.5	0.497
	Married	22	29.3	12	37.5	
Tobacco use	No	27	36	17	53.1	0.133
	Yes	48	64	15	46.9	
Alcohol use	No	71	94.7	30	93.8	**
	Yes	4	5.3	2	6.3	
Clozapine use	No	54	72	25	78.1	0.633
	Yes	21	28	7	21.9	
Long-acting antipsychotic use	No	32	42.7	16	50	0.529
	Yes	43	57.3	16	50	
CMHC registration	No	0	0	3	9.4	**
	Yes	75	100	29	90.6	

CMHC: Community mental health centers, *: $p<0.05$, **: Chi-square not applicable

Table 2. Comparison of PSP, MARS, PANSS and subscales between two group-values

Scale	TCP	n	Mean	Standard Deviation	p-value
PSP	Registered	75	62.7	13.2	0.718*
	Not registered	32	62.8	12.1	
MARS	Registered	73	7.74	1.6	0.694*
	Not registered	32	7.78	1.9	
PANSS-positive	Registered	75	12.5	5.2	0.096*
	Not registered	31	10.7	3.1	
PANSS-negative	Registered	75	16.9	6.6	0.794*
	Not registered	31	16.1	4.5	
PANSS-general	Registered	75	26.09	7.6	0.144*
	Not registered	31	23.7	5.9	
PANSS-total	Registered	75	55.4	17.9	0.286*
	Not registered	31	50.5	12.1	

p<0.05,*: Mann-Whitney U test, TCP: Treatment Collaboration Portal, PSP: Personal and Social Performance Scale, MARS: Medication Adherence Rating Scale, PANSS: Positive and Negative Syndrome Scale

Table 3. Regression analysis of factors predicting personal and social functioning

Dependent variable	Independent variables	B	Standard error	β	t	p
PSP	PANSS-positive	-0.725	0.315	-0.271	-2.297	**<0.05**
	PANSS-negative	-1.092	0.278	-0.516	-3.922	**<0.001**
	PANSS-general	0.253	0.263	0.142	0.961	0.339
	Duration until treatment initiation	-0.017	0.040	-0.035	-0.429	0.669
	Gender	0.002	2.118	0.000	0.001	0.999

PSP: Personal and Social Performance Scale, PANSS: Positive and Negative Syndrome Scale

Therefore, patients with poor adherence or known predictors of non-adherence who were registered in TCP may have predominantly been male.

In chronic and recurrent psychotic disorders, pharmacological treatment plays a crucial role both during acute exacerbation periods and in maintenance after symptom stabilization (4,27). In our sample, the mean MARS scores of both groups were close to 8, indicating that both groups demonstrated similarly partial adherence to medication (24). This may explain why no significant difference was found between the two groups in terms of medication adherence. Furthermore, studies have shown that treatment adherence improves in schizophrenia patients after registration with a CMHC (12,28). Most of the patients included in this study were stable patients followed up in CMHCs. Patients who were clinically improved and had relatively better functioning, even if not registered in TCP, were also included in the study as long as they were under CMHC follow-up. Regular monitoring and other CMHC interventions may have enhanced adherence in these individuals, potentially explaining the lack of difference between the groups. Additionally, regular CMHC follow-up may have led to a reduction in positive and negative symptom severity and thus an improvement in individual and social functioning, which may have indirectly contributed to better treatment adherence.

On the other hand, in individuals with psychotic disorders, treatment adherence encompasses more than just medication adherence and requires a broader evaluation. In this regard, the services provided by CMHCs, which are designed to enhance treatment adherence, are of particular importance. At the CMHC within our hospital, a variety of programs and training sessions are offered to both patients with psychotic disorders and their families. Home, workplace, or care facility visits are conducted by the CMHC team when necessary. Patients receive training on cognitive skills, illness self-management, psychological empowerment, and social skills. Family members receive education on illness, treatment, communication with the patient, and stress management. Additionally, healthy living groups are organized focusing on physical activity, healthy nutrition, personal hygiene, and sleep hygiene.

In addition to all these comprehensive services provided by CMHCs, TCP is a system designed to remind patients' relatives of appointment dates, medical tests, activities, and injection schedules to prevent missed treatments, with written informed consent obtained from each patient. By entering information into the portal, the treatment team ensures that reminders regarding "appointments, injections, therapy, family education, and blood tests" are sent via an IVR system to the mobile phones of the patient or their relative. The aim of TCP is to enhance adherence to treatment and rehabilitation services and

to facilitate treatment monitoring by patients and their families. Our findings indicated that merely reminding patients of medication or appointment dates via TCP did not contribute additional benefits to medication adherence. This is because the TCP system records whether or not the patient responds to the calls, and these records are monitored by the CMHC team, who then attempt to contact the patient by phone and provide the necessary reminders. Whether or not a patient is registered in TCP while under CMHC follow-up does not make a difference in terms of medication adherence, symptom severity, or individual and social functioning. The services provided in CMHCs have been shown in many studies to positively impact treatment adherence, insight, quality of life, functionality, and reduction in illness symptoms (12,28).

However, an important finding of this study was the statistically significant difference observed in the hospitalization rates calculated before and after TCP registration among registered patients. The pre-registration hospitalization rate was found to be higher than the post-registration rate. It has been reported that psychosocial interventions in chronic psychiatric disorders may have long-term effects on insight, quality of life, and hospitalization rates (29). Although this study did not identify a relationship between TCP and short-term outcomes such as symptom severity or medication adherence, the system may have contributed positively in the long term by reducing hospitalization rates.

Study Limitations

One of the limitations of this study was that the majority of the patients were already registered with the CMHC, meaning they were regularly monitored and had relatively high treatment adherence. Additionally, the cross-sectional nature of the study, lack of follow-up, and the small sample size limited the ability to assess the short- and long-term effects of TCP registration. Therefore, follow-up studies with larger samples are needed.

Conclusion

In conclusion, services provided by CMHCs contribute positively to the course of illness in individuals with chronic psychiatric disorders accompanied by psychotic symptoms. In addition, a digital system such as the TCP, which reminds patients of their follow-up information, appears to be a valuable tool in reducing the workload of CMHC teams. Moreover, it may also contribute positively to the course of illness in the long term by reducing hospitalization rates.

Ethics

Ethics Committee Approval: The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Clinical Research Ethics Committee of Dr. Abdurrahman Yurtaslan Ankara Oncology Training and Research Hospital on 27.01.2021 with decision number 2021-01/985.

Informed Consent: All participants signed an informed consent form and were informed about the study's purpose and procedures.

Footnotes

Authorship Contributions

Surgical and Medical Practices: N.B.B., F.B.E., M.A., Concept: F.B.E., E.H.K., A.Ç., Design: N.B.B., F.B.E., E.H.K., A.Ç., Data Collection or Processing: F.B.E., M.A., Analysis or Interpretation: N.B.B., F.B.E., E.H.K., Literature Search: N.B.B., F.B.E., E.H.K., M.A., Writing: N.B.B., F.B.E., E.H.K., A.Ç.

Conflict of Interest: No conflict of interest was declared by the authors.

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Original Article

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Burnout Levels and Contributing Factors Among Radiation Oncology Resident Physicians

Radyasyon Onkolojisi Asistanlarının Tükenmişlik Seviyeleri ve Etken Faktörler

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ABSTRACT

Objective: Burnout is a psychological syndrome that emerges as a long-term response to chronic workplace stress that has not been successfully managed. In fields with high emotional and physical stress, such as oncology, the prevalence of burnout is significantly high. Burnout can lead to decreased productivity among healthcare professionals, poor mental and physical health, and negative impacts on personal relationships. This study aims to assess the burnout levels of radiation oncology resident physicians in Türkiye and examine the sociodemographic factors contributing to this condition.

Methods: A total of 52 radiation oncology resident physicians in Türkiye participated in this study. A "Demographic Information Form" consisting of seven questions was used to determine the demographic characteristics of the participants, and the "the Maslach Burnout Inventory" was applied to assess professional burnout levels. This scientifically validated scale evaluates burnout in three subdimensions: emotional exhaustion, depersonalization, and personal accomplishment.

Results: A significant negative correlation was found between the emotional exhaustion and personal accomplishment dimensions, while a significant positive correlation was observed between the emotional exhaustion and depersonalization dimensions ($p<0.01$). No significant correlation was detected between the Personal Accomplishment and Depersonalization subdimensions.

ÖZ

Amaç: Tükenmişlik; kronik iş yeri stresine karşı, başarısız bir şekilde yönetilen, uzun vadeli bir yanıt olarak ortaya çıkan psikolojik bir sendromdur. Onkoloji gibi duygusal ve fiziksel stresin yüksek olduğu alanlarda tükenmişlik prevalansı yüksektir. Tükenmişlik bu alandaki sağlık profesyonellerinin üretkenliğinin azalmasına, zayıf zihinsel ve fiziksel sağlığa ve kişisel ilişkiler üzerinde olumsuz etkilere yol açabilir. Bu çalışma, Türkiye'deki radyasyon onkolojisi asistanlarının tükenmişlik düzeylerini değerlendirmeyi ve bu duruma katkıda bulunan sosyodemografik faktörleri incelemeyi amaçlamaktadır.

Yöntemler: Çalışmamıza Türkiye'deki radyasyon onkolojisi asistanları arasından 52 hekim katılmıştır. Çalışmaya katılan asistanların demografik özelliklerini tespit etmek için 7 soruluk "Demografik Bilgi Formu" ve mesleki tükenmişlik düzeylerini belirlemek için "Maslach Tükenmişlik Ölçeği" kullanılmıştır. Ölçek; duygusal tükenme, duyarsızlaşma ve kişisel başarı olmak üzere üç alt boyutta tükenmişliği değerlendiren bilimsel bir ölçektir.

Bulgular: Çalışmamızda duygusal tükenme ile kişisel başarı boyutları arasında negatif yönlü, duygusal tükenme ile duyarsızlaşma boyutları arasında pozitif yönlü anlamlı bir ilişki tespit edilmiştir ($p<0,01$). Kişisel başarı ile duyarsızlaşma alt boyutları arasında anlamlı ilişki tespit edilmemiştir.

Sonuç: Maslach Tükenmişlik Ölçeği için tanımlı cut-off değerleri bulunmadığından, ortalama puanlar ölçek aralıkları

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ABSTRACT

Conclusion: Since no cut-off values have been defined for the Maslach Burnout Inventory, mean scores were interpreted within the context of the scale ranges. Accordingly, radiation oncology residents did not generally exhibit high levels of burnout, although emotional exhaustion appeared more pronounced compared to the other subscales.

Keywords: Oncology, Maslach Burnout Inventory, burnout, emotional exhaustion, depersonalization, achievement

ÖZ

bağlamında değerlendirilmiştir. Bu bağlamda, radyasyon onkolojisi asistanlarının genel olarak yüksek tükenmişlik düzeyleri göstermediği ancak duygusal tükenmenin diğer alt boyutlara kıyasla daha belirgin olduğu görülmektedir.

Anahtar Kelimeler: Onkoloji, Maslach Tükenmişlik Ölçeği, tükenmişlik, duygusal tükenme, duyarsızlaşma, kişisel başarı

Introduction

Burnout syndrome is a complex occupational phenomenon resulting from chronic, unmanaged workplace stress. It is characterized by emotional and physical exhaustion, manifesting as persistent fatigue and behavioral distress, alongside depersonalization, reduced productivity, and diminished job satisfaction, often accompanied by depression and demoralization (1).

Oncology, a medical specialty particularly susceptible to burnout, involves significant emotional demands due to the accumulation of distress from patients' life-and-death experiences, frequent delivery of distressing news, and care for terminally ill individuals. Oncologists often face heavy workloads (1,2). Repeated exposure to death and suffering may lead to depression, cynicism, a sense of meaninglessness, and even nihilism (3).

The mental well-being of healthcare professionals in oncology plays a critical role in enhancing both the quality of life of patients and the healthcare providers themselves. Among oncologists, burnout is frequently associated with reduced quality of patient care, loss of empathy and diminished compassion. Burnout syndrome may lead to serious consequences, including depression, substance abuse, suicide, and medical errors (2).

Studies conducted across various medical specialties worldwide indicate that approximately one in three physicians experiences burnout at some point. Among oncology-related specialties, burnout prevalence has been reported to range between 25-35% among medical oncologists (4), 38% among radiation oncologists (5), and between 28-36% among surgical oncologists (6).

For many physicians, the first encounter with depression and burnout occurs during medical school. Although medical students typically enter training with mental health profiles comparable to those of other university graduates, the risk of burnout and depression tends to increase within a short period.

Research shows that up to 50% of medical students experience burnout, 25% suffer from depression, and many report chronic anxiety and poor mental health (7). The prevalence of such problems often persists at graduation and does not vary significantly according to future specialty choices (8).

During residency, burnout prevalence tends to increase, and several studies indicate that a majority of young physicians experience burnout before completing their specialty training (9). More than 50% of residents are reported to suffer from this syndrome (10).

Burnout levels are particularly high among radiation oncology residents. Providing medical care to individuals diagnosed with cancer is both a rewarding and challenging task. Oncologists are often required to make critical decisions regarding life preservation and the management of complex treatment protocols (3).

The chronic stress arising from these responsibilities frequently leads to burnout, which in turn adversely impacts residents' mental health and professional performance.

The aim of this study is to evaluate sociodemographic factors contributing to burnout and to examine the associations between these factors and the severity of burnout.

Through this survey-based study conducted among radiation oncology residents in our country, we sought to assess burnout symptoms, explore related variables, and review preventive strategies that may help mitigate the development of burnout.

Methods

This study was designed to determine the levels of occupational burnout among radiation oncology residents. To this end, the study aimed to assess the burnout levels of resident physicians and to investigate whether these levels significantly differed based on variables such as age, marital status, years of residency, willingness to choose the medical profession and the factors influencing that choice, willingness to specialize in radiation oncology, and duration of professional experience in the field.

A descriptive survey method was employed in this research. Descriptive surveys are studies conducted with large groups of participants to explore their thoughts on a particular phenomenon or event (11). This method is used to define the structure of objects, societies, and institutions, as well as the operation of events (12). Burnout levels among radiation oncology residents were examined using this approach, taking into account various variables.

This study was approved by the University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Ethics Committee (approval no: KAEK-11/11.09.2024.145, date: 17.09.2024).

The study population consisted of resident physicians currently pursuing their residency in the field of radiation oncology

in Türkiye. Data were collected from 52 participants using a purposive sampling method. The research data were obtained through an online questionnaire, distributed via Google Forms and social media platforms to relevant individuals. To ensure confidentiality, no IP addresses were recorded, responses were anonymous, and the data were used solely for scientific purposes. A total of approximately 340 resident physicians are currently enrolled in residency training programs in Türkiye. Of these, 52 residents voluntarily participated in the present study. Data collection was conducted between October 31, 2024, and April 30, 2025. The inclusion criterion was being a resident physician enrolled in a radiation oncology specialty program, whereas the exclusion criteria were lack of willingness to participate in the survey and being older than 40 years of age.

In this study, a "Demographic Information Form" was used to collect participants' sociodemographic data, and the "Maslach Burnout Inventory" (MBI) was used to assess their levels of occupational burnout.

Informed consent was obtained from all participating physicians, and participation was voluntary. Participant identities were kept confidential, and the data were used solely for scientific purposes.

The demographic form included questions on age, marital status, city of residence, duration of work in radiation oncology, whether the participant had willingly chosen the medical profession, the influencing factors behind their career choice, and whether they had voluntarily chosen the specialty of radiation oncology.

The MBI was originally developed by Maslach and Jackson in 1981 to measure burnout in professionals working in face-to-face services and was revised in 1986. The inventory consists of 22 items across three subscales: "emotional exhaustion" (9 items), "depersonalization" (5 items), and "personal accomplishment" (8 items). In the Turkish version of the scale, a five-point Likert scale was used instead of the original seven-point response format. Each subscale is scored separately. High scores in the emotional exhaustion and depersonalization subscales, and low scores in the personal accomplishment subscale indicate higher levels of burnout. The scale was adapted into Turkish by Canan Ergin in 1992, and its validity and reliability study was conducted by researcher Olcay Çam.

Based on reliability analyses, the Cronbach's alpha coefficients for the three subscales of the MBI were as follows: 0.83 for emotional exhaustion, 0.65 for depersonalization, and 0.72 for personal accomplishment. In subsequent test-retest analyses, the reliability coefficients were recalculated, resulting in 0.83 for emotional exhaustion, 0.72 for depersonalization, and 0.67 for personal accomplishment.

The data used in this study were obtained through the administration of the "Demographic Information Form" and the "MBI" to the participants. Quantitative analyses were conducted using SPSS version 27.0.1. The normality of data distribution was assessed through skewness and kurtosis analyses. The reliability of the study was tested using Cronbach's alpha analysis. To examine the differences between scale subdimensions and influencing variables, one-way analysis of variance (ANOVA) tests were conducted. To identify which groups contributed to significant differences, the Scheffé post-hoc multiple comparison test was applied. A p-value of less than 0.05 was considered statistically significant.

Results

Descriptive statistics related to the scales used in the study are as follows: the emotional exhaustion subscale had a mean score of 15.52, standard deviation (SD) of 5.943, skewness values of 0.530/0.330, kurtosis values of 0.754/0.650, and a Cronbach's alpha coefficient of 0.866. The personal accomplishment subscale had a mean score of 19.96, SD of 3.331, skewness value of -0.283/0.330, kurtosis value of 0.324/0.650, and a Cronbach's alpha of 0.649. The depersonalization subscale had a mean score of 5.88, SD of 3.027, skewness values of 0.018/0.330, kurtosis values of -0.969/0.650, and a Cronbach's alpha of 0.632 (Table 1).

In the study group, 30.8% (n=16) were married, and 69.2% (n=36) were single. Of the participants, 42.3% (n=22) lived in İstanbul, while the rest resided in other major cities. Of the participants, 88.5% (n=46) stated that they had chosen the medical profession willingly, whereas 11.5% (n=6) had not. In terms of the specialty field, 94.2% (n=49) reported willingly choosing radiation oncology, while 5.8% (n=3) had not. Among the physicians participating in the study, 28.8% (n=15) had been working in the field for 0-1 year, 13.5% (n=7) for 1-2 years, 25% (n=13) for 2-3 years, 11.5% (n=6) for 3-4 years, 15.4% (n=8) for 4-5 years, and 5.8% (n=3) for more than 5 years. Of the physicians 42.3% (n=22) had chosen their profession voluntarily, while 38.4% (n=20) had chosen it due to other reasons, and 19.2% (n=10) were influenced by both personal desire and other factors (Table 2).

Participants' ages ranged from 25 to 39, with a calculated mean age of 28.69 (Table 3).

Correlations between the subscales of the MBI were examined. A moderate, negative, and statistically significant correlation was found between emotional exhaustion and personal accomplishment subscales (r=-0.391, p<0.01). As low scores in

Table 1. Descriptive statistics of the scales used in the study

	N	$\bar{x}$: Mean	SD	Skewness	Kurtosis	α
Emotional exhaustion	52	15.52	5.943	0.530 (SE = 0.330)	0.754 (SE = 0.650)	0.866
Personal accomplishment	52	19.96	3.331	-0.283 (SE = 0.330)	0.324 (SE = 0.650)	0.649
Depersonalization	52	5.88	3.027	0.018 (SE = 0.330)	-0.969 (SE = 0.650)	0.632

N: Number of participants, $\bar{x}$: Mean, SD: Standard deviation, α: Cronbachs alpha

the personal accomplishment subscale and high scores in the emotional exhaustion subscale indicate high burnout, it can be inferred that as emotional exhaustion scores increase, personal accomplishment scores decrease. A moderate, positive, and statistically significant correlation was found between emotional exhaustion and depersonalization (r=0.411, p<0.01). Since high scores in both subscales are associated with high burnout, it can be concluded that emotional exhaustion and depersonalization scores tend to increase or decrease together. No significant relationship was found between the personal accomplishment and depersonalization subscales (Table 4).

The independent samples t-test used to compare the subscale scores of the MBI by marital status showed no statistically significant differences in emotional exhaustion, personal accomplishment, or depersonalization subscales (p=0.140, p=0.354, and p=0.089, respectively). However, it was observed that married participants had lower average burnout scores compared to single participants (Table 5).

Independent samples t-test results regarding the comparison of subscale scores by willingness to choose the medical profession revealed no significant differences in the personal accomplishment or depersonalization subscales (p=0.257 and p=0.274, respectively). However, a significant difference was found in the emotional exhaustion subscale to the disadvantage of those who had not willingly chosen the profession (t=-2.613, p=0.012). In other words, the emotional exhaustion level of those who willingly chose the profession was significantly lower than that of those who did not (Table 6).

According to the independent samples t-test results comparing subscale scores based on willingness to choose the field of radiation oncology, no statistically significant differences were found in emotional exhaustion, personal accomplishment, or depersonalization subscales (p=0.051; 0.077; and 0.947, respectively). Although the mean burnout scores of those who had willingly chosen the field were lower than those who had not, the difference was not statistically significant (Table 7).

The results of the one-way ANOVA test applied to determine whether age is associated with differences in the subscale scores showed that emotional exhaustion levels significantly differed by age (F=2.126; p=0.044). No significant differences were found in personal accomplishment and depersonalization subscales by age (p=0.364) However, the effect sizes were small ($\eta^2 \approx 0.02$), with mean differences of up to 5-6 points in personal accomplishment and 2-3 points in depersonalization, suggesting limited clinical relevance (Table 8).

The results of the one-way ANOVA test conducted to identify the differences between subscale scores and years of experience in radiation oncology showed no significant relationships (p=0.268) (Table 9).

The results of the one-way ANOVA test conducted to determine differences in subscale scores by city of residence showed no significant relationship between location and subscale scores (p=0.632) (Table 10).

Table 2. Demographic characteristics

	Groups	N	%
Marital status	Married	16	30.8
	Single	36	69.2
City of residence	İstanbul	22	42.3
	Ankara	8	15.4
	İzmir	7	13.5
	Antalya	3	5.8
	Bursa	3	5.8
	Konya	3	5.8
	Samsun	2	3.8
	Trabzon	2	3.8
	Kayseri	1	1.9
	Malatya	1	1.9
Willingness to choose the medical profession	Yes	46	88.5
	No	6	11.5
Willingness to choose radiation oncology as a specialty	Yes	49	94.2
	No	3	5.8
Years of experience in radiation oncology	0-1	15	28.8
	1-2	7	13.5
	2-3	13	25.0
	3-4	6	11.5
	4-5	8	15.4
	>5	3	5.8
Factors influencing career choice	Personal choice	22	42.3
	Personal choice and other factors	20	38.4
	Other factors	10	19.2

N: Number of participants

Table 3. Descriptive statistics for age

	N	Min.	Max.	$\bar{x}$: Mean	SD
Age	52	25	39	28.69	2.839

N: Number of participants, Min.: Minimum, Max.: Maximum, $\bar{x}$: Mean, SD: Standard deviation

Table 4. Correlation analysis of subscale scores

		1	2	3
1- Emotional exhaustion	r	1	-0.391**	0.411**
2- Personal accomplishment	r		1	-0.210
3- Depersonalization	r			1

**: p<0.01, r: Pearson correlation coefficient

Table 5. Independent samples t-test comparing subscale scores based on marital status

	Marital status	N	x̄: Mean	SD	t-value	DF	p-value
Emotional exhaustion	Married	16	13.69	5.016	-1.500	50	0.140
	Single	36	16.33	6.201			
Personal accomplishment	Married	16	19.31	3.092	-0.936	50	0.354
	Single	36	20.25	3.434			
Depersonalization	Married	16	4.81	2.786	-1.736	50	0.089
	Single	36	6.36	3.044			

x̄: Mean, SD: Standard deviation, DF: Degrees of freedom

Table 6. Independent samples t-test comparing subscale scores based on willingness to choose medical profession

	Willing dr choice	N	x̄: Mean	SD	t-value	DF	p-value
Emotional exhaustion	Yes	46	14.78	5.762	-2.613	50	0.012
	No	6	21.17	4.262			
Personal accomplishment	Yes	46	20.15	3.353	1.146	50	0.257
	No	6	18.50	3.017			
Depersonalization	Yes	46	5.72	2.896	-1.105	50	0.274
	No	6	7.17	3.971			

Willing dr choice: Willingness to choose the medical profession, x̄: Mean, SD: Standard deviation, DF: Degrees of freedom

Table 7. T-test comparison of subscale scores by willingness to choose radiation oncology

	Willing RO choice	N	x̄: Mean	SD	t-value	DF	p-value
Emotional exhaustion	Yes	49	15.12	0.772	-2.003	50	0.051
	No	3	22.00	11.533			
Personal accomplishment	Yes	49	20.16	3.319	1.803	50	0.077
	No	3	16.67	1.155			
Depersonalization	Yes	49	5.88	3.113	-0.067	50	0.947
	No	3	6.00	1.000			

Willing RO choice: Willingness to choose radiation oncology, x̄: Mean, SD: Standard deviation, DF: Degrees of freedom

Table 8. One-way ANOVA analysis comparing subscale scores based on age (one-way ANOVA, F (10.41) = 2.126)

	Groups	N	x̄: Mean	SD	F-value	p-value
Emotional exhaustion	25	5	16.00	4.637	2.126	0.044
	26	4	17.00	7.528		
	27	12	12.17	5.078		
	28	8	17.88	6.643		
	29	9	15.11	5.085		
	30	2	28.00	7.071		
	31	6	14.50	3.886		
	33	2	14.50	2.121		
	34	2	20.50	0.707		
	35	1	12.00	.		
	39	1	9.00	.		

Table 8. Continued

	Groups	N	x̄: Mean	SD	F-value	p-value
Personal accomplishment	25	5	19.00	1.000	1.131	0.364
	26	4	20.25	6.946		
	27	12	20.08	2.999		
	28	8	19.38	1.685		
	29	9	18.56	3.575		
	30	2	17.00	1.414		
	31	6	23.33	3.141		
	33	2	20.50	2.121		
	34	2	20.00	4.243		
	35	1	23.00	.		
	39	1	21.00	.		
Depersonalization	25	5	7.20	2.588	1.111	0.377
	26	4	7.50	1.915		
	27	12	5.42	3.288		
	28	8	7.13	1.885		
	29	9	5.44	3.046		
	30	2	6.00	1.414		
	31	6	3.67	3.933		
	33	2	3.50	0.707		
	34	2	7.00	5.657		
	35	1	4.00	.		
	39	1	10.00	.		

ANOVA: Analysis of variance, x̄: Mean, SD: Standard deviation

Table 9. One-way ANOVA analysis comparing subscale scores based on duration of work in radiation oncology (one-way ANOVA, F (5.46) = 1.332)

	Groups	N	x̄: Mean	SD	F-value	p-value
Emotional exhaustion	0-1	15	15.33	5.219	1.332	0.268
	1-2	7	16.86	8.194		
	2-3	13	13.15	4.828		
	3-4	6	19.83	2.041		
	4-5	8	16.38	8.141		
	>5	3	12.67	3.512		
Personal accomplishment	0-1	15	19.33	2.870	1.608	0.177
	1-2	7	18.57	4.756		
	2-3	13	21.15	2.911		
	3-4	6	18.17	2.483		
	4-5	8	20.75	3.576		
	>5	3	22.67	2.082		
Depersonalization	0-1	15	6.73	2.738	0.591	0.707
	1-2	7	6.29	1.976		
	2-3	13	5.46	3.282		
	3-4	6	6.17	3.764		
	4-5	8	5.00	2.878		
	>5	3	4.33	5.132		

ANOVA: Analysis of variance, x̄: Mean, SD: Standard deviation

The one-way ANOVA test results used to examine the differences between subscale scores and factors affecting career choice revealed a statistically significant difference in emotional exhaustion levels based on career decision factors (F=3.966; p=0.025). The Scheffé post-hoc test conducted to determine the source of the group differences showed that those who had chosen medicine based on personal interest had significantly lower emotional exhaustion scores than those influenced by other factors (Table 11).

Discussion

In recent years, burnout has become an increasingly recognized issue, particularly among healthcare providers working in cancer care (1). Although various factors contribute to physician burnout, excessive workload, a sense of inefficacy, and loss of autonomy appear to be primary contributors. Historically, physicians often owned their own practices, hired support staff, and had considerable control over their schedules, pace of work, hours, and the number of patients seen per day. Today, however, most oncologists-especially radiation oncologists-are employees of hospital groups, cancer centers, academic medical centers, or multi-specialty groups, with significantly less control over these aspects of practice. Productivity targets are often set by practice administrators and are quantitatively measured in great detail (13).

Other studies suggest that emotionally demanding professional responsibilities-such as breaking bad news, weighing the risks and benefits of selected treatments, choosing therapies with side effects, or coping with administrative burdens-may increase the risk of burnout among oncologists (13).

This study presents findings from an investigation into burnout levels and related factors among radiation oncology residents in Türkiye.

Descriptive statistics and reliability testing via Cronbach's alpha for the emotional exhaustion, depersonalization, and personal accomplishment subscales were consistent with the original MBI values (α=0.83, 0.72, and 0.65, respectively). Our study found similar reliability coefficients of 0.866, 0.649, and 0.632, respectively, demonstrating consistency with the original instrument (14).

Table 10. One-way ANOVA analysis comparing subscale scores based on city of residence (one-way ANOVA, F (3.48) = 0.784)

	Groups	N	$\bar{x}$: Mean	SD	F-value	p-value
Emotional exhaustion	İstanbul	22	14.86	5.480	0.784	0.632
	Ankara	8	19.00	8.246		
	İzmir	7	14.86	6.962		
	Other cities*	15	14.60	5.100		
Personal accomplishment	İstanbul	22	19.32	2.998	0.431	0.911
	Ankara	8	20.13	3.523		
	İzmir	7	20.29	5.122		
	Other cities*	15	20.40	3.780		
Depersonalization	İstanbul	22	6.05	3.498	0.892	0.541
	Ankara	8	5.38	2.825		
	İzmir	7	5.86	2.340		
	Other cities*	15	6.27	2.890		

ANOVA: Analysis of variance, $\bar{x}$: Mean, SD: Standard deviation, *: Antalya, Bursa, Konya, Samsun, Trabzon, Kayseri, Malatya

Table 11. One-way ANOVA analysis comparing subscale scores based on factors influencing career choice (one-way ANOVA, F (2.49) = 3.966)

	Groups	N	$\bar{x}$: Mean	SD	F-value	p-value	Difference*
Emotional exhaustion	Personal choice	22	14.23	5.580	3.966	0.025	1<2
	Other factors	10	20.00	5.774			
	Personal choice and other factors	20	14.70	5.602			
Personal accomplishment	Personal choice	22	19.68	3.045	2.364	0.105	
	Other factors	10	18.40	4.088			
	Personal choice and other factors	20	21.05	3.000			
Depersonalization	Personal choice	22	5.55	2.890	0.849	0.434	
	Other factors	10	7.00	3.771			
	Personal choice and other factors	20	5.70	2.793			

*: Difference 1<2. 1 = personal choice, 2 = other factors the emotional exhaustion scores of those who chose their profession voluntarily were significantly lower than those of individuals who chose it due to other factors, $\bar{x}$: Mean, SD: Standard deviation

According to the 2024 data collected from radiation oncology residents in Türkiye, the mean emotional exhaustion score (range 0-36) was 15.52, the personal accomplishment score (range 0-32) was 19.96, and the depersonalization score (range 0-20) was 5.88. Although the MBI does not have defined cutoff scores, high scores in emotional exhaustion and depersonalization, combined with low scores in personal accomplishment, indicate high levels of burnout (15). When comparing these averages to the maximum possible scores, the participants in this study did not exhibit high levels of burnout overall.

However, considering the total number of residents in this specialty, the low participation rate in an online survey that required only a few minutes to complete is noteworthy. This may increase the likelihood of selection bias and limit the generalizability of the results. Oncologists are under immense stress. Symptoms such as lack of empathy and dissatisfaction with work-often observed in themselves and colleagues-may be manifestations of burnout. While prioritizing patient care is expected, the well-being of physicians is equally critical. This has implications not only for healthcare providers but also for patients and their families (16).

The participants' ages ranged from 25 to 39 years, with a mean of 28.69. Our analysis found a statistically significant relationship between age and emotional exhaustion (F=2.126; p=0.044), but not with Depersonalization or personal accomplishment (p=0.364 and 0.377, respectively).

No significant associations were found between years of experience in radiation oncology and burnout subscale scores. However, numerous studies have identified age and professional experience as significant factors associated with burnout, with higher prevalence among younger physicians. These findings emphasize the increased burnout risk in junior physicians and residents at lower hierarchical levels (13,17).

To avoid gender bias, this study did not include gender-based analysis. Other studies in the literature have similarly reported no significant gender-based differences in burnout rates among male and female oncologists (17).

Among our participants, 30.8% (n=16) were married, while 69.2% (n=36) were single. No statistically significant differences were observed in emotional exhaustion, personal accomplishment, or depersonalization scores based on marital status (p=0.140, 0.354, and 0.089, respectively). However, average burnout scores were lower among married participants.

Research suggests that marital status may meaningfully influence the burnout experience of oncologists. While marriage can provide emotional support and stability, it may also present challenges in balancing personal responsibilities with demanding work schedules, which could contribute to feelings of burnout (18).

No significant differences were found in the personal accomplishment or depersonalization subscales based on whether physicians had willingly chosen their profession (p=0.257 and 0.274). However, the mean differences were 1.65 points in personal accomplishment and 1.45 points in depersonalization, with small-to-moderate effect sizes ($d\approx0.49$ and $d\approx0.42$, respectively), suggesting potential clinical relevance despite the lack of statistical significance (Table 6). However, emotional exhaustion scores were significantly higher among those who had not willingly chosen the medical profession (t=-2.613, p=0.012).

Moreover, emotional exhaustion scores significantly differed based on the factors influencing career choice (F=3.966; p=0.012). Post-hoc Scheffé analysis revealed that those who chose the profession voluntarily had significantly lower emotional exhaustion scores than those influenced by other factors.

This finding raises important questions about the long-term impact of career choice on mental health in medicine. Individuals who enter the field with genuine passion may be better equipped to manage the emotional demands of their work, resulting in lower burnout levels and higher job satisfaction. Conversely, individuals who enter the field due to pressure or obligation may experience higher stress levels, which not only impact them personally but may also compromise the quality of patient care (19).

No significant differences were found in any subscales based on whether participants had willingly chosen the field of radiation oncology (p=0.051, 0.077, and 0.947). Although mean burnout scores were lower among those who had voluntarily chosen the field, the differences were not statistically significant. However, the mean differences were 6.88 points in emotional exhaustion and 3.49 points in personal accomplishment, corresponding to large effect sizes ($d\approx0.92$ and $d\approx1.15$, respectively). In contrast, the difference in depersonalization was negligible (mean difference =0.12; $d\approx0.04$) (Table 7). These findings highlight broader questions about the impact of specialty choice on burnout in radiation oncology. It is essential to consider additional factors contributing to emotional exhaustion and job satisfaction. For example, insufficient clinical support and heavy administrative burdens have been widely identified as major contributors to burnout across various specialties. Additionally, the emotional toll of patient interactions in oncology may lead to frustration and eventual depersonalization, regardless of initial enthusiasm (20).

According to our survey data, no significant associations were found between years of experience in radiation oncology and the emotional exhaustion, personal accomplishment, and depersonalization subscales (p=0.268, 0.177, and 0.707, respectively).

However, global data show that oncologists often face long working hours, which significantly contribute to stress and burnout. The demanding nature of the job-particularly rising patient loads and expectations-can lead to reduced job satisfaction and increased burnout (21).

No significant differences were found between city of residence and any of the burnout subscales (p=0.632, 0.911, and 0.541). Effect sizes were small ($\eta^2<0.05$), with mean differences of up

to 5-6 points across cities, suggesting limited clinical relevance. Given that radiation oncology clinics in Türkiye are primarily located in major cities, this result is expected.

A review of the literature reveals that burnout is a significant concern for healthcare professionals worldwide. The limited participation in our study may stem from reluctance to acknowledge the issue. There is a pressing need for more comprehensive research in Türkiye to explore this topic in greater depth.

Recommendations

Beyond examining sociodemographic factors, it is critical to consider the institutional environment and support systems provided to oncology residents, as these factors can substantially impact burnout levels. Research has shown that residency programs that include time for academic development and mental health support can reduce emotional exhaustion and depersonalization among young physicians (22).

Furthermore, promoting a culture of open communication with senior physicians and fostering peer support within residency programs can enhance resilience and facilitate a healthier work-life balance, ultimately improving the overall well-being of oncology residents.

Mentorship and guidance from senior physicians play a crucial role in combating burnout. Studies have shown that effective mentorship provides not only emotional support but also practical strategies for navigating the complexities of residency, helping to alleviate feelings of isolation and stress (23).

In addition to structured wellness programs, regular meetings with mentors may help detect early signs of burnout and allow timely interventions. Addressing systemic issues such as work-hour policies and workload distribution is also essential. Research has demonstrated that balanced approaches to these factors are associated with lower burnout rates and increased job satisfaction among residents (22,24).

By prioritizing both individual support mechanisms and institutional reforms, residency programs can foster environments that promote resilience and professional fulfillment, ultimately benefiting both healthcare providers and their patients.

In addition to the strategies outlined above, integrating mindfulness practices and resilience training into residency programs has emerged as a promising approach to combating burnout among oncology residents. Mindfulness-based stress reduction programs have been shown to significantly reduce stress levels while enhancing emotional regulation and self-compassion, which are critical in high-pressure medical environments. Such initiatives can help residents feel more connected and less isolated, thereby alleviating the depersonalization often associated with burnout (23).

Moreover, several European countries have systematically embedded practices aimed at mitigating burnout into their institutional frameworks. For instance, in some clinics in Germany, weekly group therapy sessions are held, where early-career physicians are actively supported by more senior colleagues through shared experiences. Furthermore, regular team-based activities such as running and meditation promote both physical and mental well-being, while fostering stronger team cohesion. In certain institutions, artistic initiatives-such as physician-led choirs and orchestras-are organized to encourage creative, non-clinical approaches to stress relief. These practices contribute not only to individual well-being but also to the cultivation of institutional solidarity, thereby serving as a meaningful support structure in addressing burnout.

By adopting a holistic approach that equally values mental health and professional development, institutions can not only empower their residents but also enhance the overall effectiveness of cancer care (25).

Study Limitations

This study has several limitations. This study included 52 radiation oncology residents. The limited sample size may restrict the generalizability of the findings. To avoid gender bias, this study did not include gender-based analysis. Other studies in the literature have similarly reported no significant gender-based differences in burnout rates among male and female oncologists (16).

The research was conducted using a voluntary sampling approach and a cross-sectional design. This may introduce participant bias and limit the ability to assess changes in burnout levels over time.

Future studies with larger samples are needed to more comprehensively understand the dynamics of burnout among radiation oncology residents. Finally, the MBI used in this study does not have established cut-off values, which limits the ability to categorize burnout severity. The anonymized dataset generated and analyzed during the current study will be made available upon reasonable request.

Conclusion

Burnout, which has emerged as a defining issue of our era for working populations both globally and within our country, exerts its influence on physicians from the very outset of medical education. In the early stages of our professional careers-particularly in emotionally demanding disciplines such as oncology, where continuous patient interaction and complex decision-making are inherent-this phenomenon tends to escalate progressively.

Strategies proposed to safeguard physicians' mental well-being and enhance job satisfaction are regarded as a significant step toward mitigating burnout levels. Within this framework, our objective is to underscore the importance of both individual support mechanisms and systemic institutional reforms.

Ethics

Ethics Committee Approval: This study was approved by the University of Health Sciences Türkiye, Başakşehir Çam and

Sakura City Hospital Hospital Ethics Committee (approval no: KAEK-11/11.09.2024.145, date: 17.09.2024).

Informed Consent: Informed consent was obtained from all participating physicians, and participation was voluntary.

Footnotes

Authorship Contributions

Concept: K.Ç., E.T.E., H.K., Design: K.Ç., E.T.E., S.S., H.K., Data Collection or Processing: S.S., Analysis or Interpretation: E.T.E., A.Y.T., Literature Search: K.Ç., S.S., Writing: K.Ç., E.T.E.

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Original Article

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Evaluation of Health Insurance Companies' Working Models: AHP and COPRAS Based Decision Support Approach

Sağlık Sigorta Şirketlerinin Çalışma Modellerinin Değerlendirilmesi: AHS ve COPRAS Tabanlı Karar Destek Yaklaşımı

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ABSTRACT

Objective: The aim of this study is to determine the importance of the criteria that influence the working models of health insurance companies and to provide a decision support approach for selecting the most appropriate working model.

Methods: Working models and the criteria influencing them were identified through a literature review. Their weights and rankings were evaluated by 5 experts from the fields of health management, occupational health and safety, management and strategy, banking and insurance, and business administration. The analytical hierarchy process (AHP) method was used to determine the importance of the criteria, and the complex proportional assessment (COPRAS) method was used to rank the study models.

Results: According to the AHP results, the weights of the most important criteria affecting the working models of health insurance companies were found to be 23.04% cost effectiveness, 20.38% customer satisfaction, and 18.84% employee productivity. According to the COPRAS results, the most appropriate working models for health insurance companies were identified as 18.02% hybrid working, 15.76% flexible working, and 14.58% part-time project-based working.

Conclusion: To popularize these models, companies should establish a strong technological infrastructure. Remote work support, cloud systems, virtual private network, video conferencing tools, and project management software should be integrated. Evaluation should focus on work output rather than hours. Data security policies must be clear. An authorized access

ÖZ

Amaç: Bu çalışmada sağlık sigorta şirketlerinin çalışma modellerini etkileyen kriterlerin önem derecelerinin belirlenmesi ve en uygun çalışma modelinin seçimi için bir karar destek yaklaşımı oluşturulması amaçlanmıştır.

Yöntemler: Çalışma modelleri ve etkileyen kriterler alan yazın taraması ile tespit edilerek; ağırlıkları ve sıralamaları sağlık yönetimi, iş sağlığı ve güvenliği, yönetim ve strateji, bankacılık ve sigortacılık ve işletme alanlarından 5 uzman tarafından değerlendirilmiştir. Kriterlerin önem derecelerinin tespiti için analitik hiyerarşi süreci (AHS) yöntemi; çalışma modellerinin sıralamaları için ise karmaşık orantılı değerlendirme (COPRAS) yöntemi kullanılmıştır.

Bulgular: AHS sonuçlarına göre; sağlık sigorta şirketlerinin çalışma modellerini etkileyen en önemli kriterlerin ağırlıkları %23,04 maliyet etkinliği, %20,38 müşteri memnuniyeti ve %18,84 çalışan verimliliği olarak bulunmuştur. COPRAS sonuçlarına göre ise sağlık sigorta şirketleri için en uygun çalışma modelleri ağırlıkları %18,02 hibrit çalışma, %15,76 esnek çalışma ve %14,58 yarı zamanlı-proje bazlı çalışma olarak belirlenmiştir.

Sonuç: Sonuç olarak, bu modellerin yaygınlaştırılması için uzaktan çalışmayı destekleyen güçlü bir teknolojik altyapı, bulut tabanlı sistemler, sanal özel ağ çözümleri, video konferans araçları ve proje yönetimi yazılımları gibi araçların kullanımı sürece entegre edilmelidir. Çalışma saatlerinden ziyade iş çıktısına odaklanan bir değerlendirme sistemi kurulmalıdır. Esnek ve proje bazlı çalışanlar için veri güvenliği politikaları net bir şekilde tanımlanarak yetkilendirilmiş erişim modeli benimsenmelidir. Ekiplerin etkin

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ABSTRACT

model should be used. Online project management platforms are needed for team management. Project-based payment systems should be implemented. Companies must analyze their processes. They should match models to departments and tasks. A strategic combination of models can boost employee satisfaction and operational efficiency.

Keywords: Health management, health facilities, health insurance companies, working model, decision-making techniques

ÖZ

yönetimi için çevrimiçi proje yönetim platformları kullanılmalı ve proje bazlı hakediş ödeme sistemleri devreye alınmalıdır. Bu doğrultuda, sağlık sigorta şirketlerinin öncelikle iş süreçlerini analiz ederek hangi modelin hangi departman veya görev için daha uygun olduğunu belirlemeleri gerekir. Şirketlerin, bu modelleri stratejik bir yaklaşımla harmanlayarak hem çalışan memnuniyetlerini artırması hem de operasyonel verimliliklerini sağlayabilmesi mümkündür.

Anahtar Kelimeler: Sağlık yönetimi, sağlık tesisleri, sağlık sigorta şirketleri, çalışma modeli, karar verme teknikleri

Introduction

With the rapid advancement of technology and the increasing impact of digitalization on business, traditional office-based working models are undergoing significant changes. Alternative working styles, such as remote working, hybrid working, and digital nomad models, have become increasingly common, particularly in the wake of the pandemic. Working models have significant impacts not only on the motivation and productivity of employees, but also on companies' operational processes and customer satisfaction (CS). In a market where innovative technologies and service delivery methods significantly affect consumer decisions, health insurance companies need to adapt their working models to effectively incorporate technology to remain competitive (1,2). Integration of different working models into processes is important to create integrated service ecosystems that can better meet the needs of consumers. The decision-making process regarding operating models in health insurance companies is related to various theoretical frameworks as well as their practical importance. When these theories are considered, organizational change theory suggests that organizations need to adapt their structures and processes in response to technological innovations and external environmental pressures (3,4). Strategic management theory, which includes concepts such as competitive advantage and cost leadership, explains how operational decisions such as choosing an appropriate operating model are important for maintaining organizational performance and competitiveness (5,6). Furthermore, digital transformation theory emphasizes the integration of digital tools and the importance of data security in new operating models, underlining the role of technology in redesigning business operations (7,8). These theories provide a basic framework for understanding the criteria evaluated in this study and interpreting empirical findings in a broader organizational and strategic context. Furthermore, decision-making processes in health insurance companies are sometimes influenced by factors such as limited information, time pressure, and managers' differing interpretations of the external environment. This situation aligns with the theory of bounded rationality. Indeed, the choice of different working models varies depending on factors such as organizational culture, structure, size, resource and talent capital, and external environmental conditions, necessitating a contingency approach. Comparison of different working models in health insurance companies directly affects the performance of employees and organizational structures (9,10). In this context, it is thought that examining the working models specific to health insurance companies will make a significant contribution to both academic literature and industry practices. The use of multi-criteria decision-making (MCDM) techniques also allows decision makers in health insurance companies to solve the complex and multi-dimensional problems they face in a more rational and evidence-based way (11).

Health insurance companies apply several different working models, each with its pros and cons. Full-time office work is the traditional employment model that asks employees to work standard hours at a central location. This model allows for direct supervision and collaboration among all team members, which means improved communication and teamwork (12). Of course, these benefits come at the price of job dissatisfaction because rigidity in schedules and the stress of commuting negatively affect employee morale (13). The hybrid working model blends in-person and remote work modalities, allowing employees to choose where and when they work. This flexibility has the potential to improve job satisfaction and work-life balance by making employees feel more valued (14). In such models, performance may improve due to increased employee autonomy and satisfaction, but it should not be overlooked that it may also cause difficulties in communication and maintaining corporate culture (15). The rise of full-time remote work has occurred in full-time positions, especially after the coronavirus disease 2019 (COVID-19) pandemic. Working remotely allows individuals to save money in some areas, such as commuting and gas, and also makes it easier to maintain a balanced life. Yet, working remotely can lead to the feeling of being disconnected and isolated from the workplace and one's coworkers. This disconnect can lead to poor communication that might affect remote workers' teams and the individual remote workers' health (16). There is also a model of work that is for those who wish to travel to different places and work. This model is called the digital nomad model, and it allows for multiple remote work locations. These types of working models allow for a lot of creativity and increased job satisfaction. However, it may cause some operational inefficiencies in terms of sustainable communication and adapting to different time zones (17,18). Shift work (SW) can be implemented in health insurance companies that provide 24/7 service. It is valuable in terms of providing uninterrupted and continuous service, but it is also risky in terms of causing employee fatigue and health problems due to working hours (19,20). Flexible working models allow employees to modify their working hours in accordance with their demands (21,22).

This increases job satisfaction and commitment and can also be effective in driving down costs and boosting motivation for businesses (23). Models that are part-time and project-based allow individuals to work in a manner that is much more temporary and without the fixed hours or commitments that some jobs require. These individuals can also adapt their work to personal responsibilities and interests. This model can potentially drive up job satisfaction, but it also lacks the model's push toward stability that is associated with traditional employment. Risks can also accumulate under this model that are associated with long-term financial security and employee loyalty to organizations (24).

Furthermore, the performance of the work models of health insurance companies is affected by many criteria. These are noteworthy in the literature. CS plays a very important role in the health insurance sector. However, it has been revealed that service quality and the perceived value of health insurance are very important determinants of CS (25,26). Similarly, a motivated and productive workforce can improve service delivery and thus promote CS (27,28). Indeed, it is emphasized that workplace environments that support work-life balance are strongly associated with increased productivity and employee well-being (29-31). It shows that a well-established data security infrastructure and crisis management plans can increase operational flexibility and thus facilitate better service delivery and customer retention (32,33). It is emphasized that cost efficiency can be increased without compromising service quality with innovations in insurance products and models. Indeed, organizations that adopt data-driven approaches and new technologies tend to effectively reduce increasing operational costs (34). Transparent communication regarding costs, benefits, and claim processes increases customer trust and satisfaction (35). On the other hand, team communication and collaboration are among the key operational components that can increase overall service efficiency. Effective communication within teams fosters a collaborative environment that can ensure timely decision-making and more effective service delivery (36,37). Companies that regularly conduct risk analyses and create contingency plans are better equipped to cope with unexpected disruptions, ensure service continuity, and protect their customer base during crises (38,39). It is underlined that these strategies must be integrated into the core operational framework and working models of health insurance companies to ensure long-term sustainability and competitiveness in the insurance market (40).

In this direction, this study aimed to determine the importance of the criteria affecting the working models of health insurance companies and to create a decision support approach for the selection of the most appropriate working model. This study is conducted within the context of the Turkish health insurance market, which operates under a mixed system involving both public and private health insurance providers. Although many working models are globally comparable, the organizational structures and regulatory frameworks relevant to health insurance in Türkiye have unique characteristics shaped by the complementary role of private insurance alongside the social security institution. Therefore, the findings are primarily contextualized within the Turkish health insurance sector.

Methods

Type and Design of the Research

This research is a quantitative study conducted to create a decision support approach for the selection of the most appropriate working model for health insurance companies. In the study, the analytical hierarchy process (AHP) and complex proportional assessment (COPRAS) methods, which are MCDM approaches, were used. Therefore, the research design is descriptive and cross-sectional. The research scope focuses on health insurance companies operating in Türkiye. Thus, expert evaluations and data collected in this study reflect the specific characteristics, regulations, and operational conditions of the Turkish health insurance market.

Determination of Working Models and Criteria

In the study, the working models of health insurance companies and the criteria affecting the models were grouped under seven categories as a result of the literature review and are expressed in Tables 1,2 with their explanations and sources. The selection of criteria and the use of AHP and COPRAS methods are consistent with organizational change theory, which suggests that systematic decision-making processes are essential for organizations facing complex environmental shifts (3), and with strategic management theory, which underlines the strategic importance of operational decisions for competitive advantage (5,6).

In order to determine the weights of the criteria affecting the working models, 5 experts from the fields of health management, occupational health and safety, management and strategy, banking and insurance, and business were consulted through AHP questionnaires. AHP questionnaires consist of questions based on pairwise comparisons with importance levels ranging from 1 to 9. In the next stage, the COPRAS method was used in line with the weighted criteria to determine the most beneficial working models for health insurance companies. Table 3 provides detailed information about the experts.

Statistical Analysis

This study employs a two-stage MCDM approach. In the first stage, the AHP was used to determine the relative importance (weights) of evaluation criteria through pairwise comparisons and consistency checks. The eigenvector weights obtained from AHP represent the ratio scale results expressing the relative importance of the criteria to each other (41). In the second stage, the weights obtained from the AHP analysis results were integrated into the COPRAS method, which requires the criterion weights to determine the normalized performance scores of the alternatives. While AHP is based on pairwise comparisons and consistency verification, COPRAS uses a linear additive benefit model. Although AHP and COPRAS differ in their conceptual foundations, the use of the weights obtained from the AHP analysis for COPRAS analysis is theoretically valid under certain conditions. To ensure methodological consistency, the sum of the AHP weights was normalized to be 1 and the ratio scale results were converted to appropriate proportional values

for additive models such as COPRAS (42,43). In addition, in order for COPRAS to remain on an interval scale in the study, the alternative scores used were independently collected through expert evaluations on a Likert scale in accordance with the weighted addition principle. Some studies in the literature indicate that integrating AHP-derived weights into different MCDM methods, including COPRAS, will yield robust and interpretable results, provided that normalization and scale consistency are managed appropriately (42-44). The methodological integration in this study was designed by the principles of AHP for reliable criterion weighting and COPRAS for ranking alternatives based on cost-benefit analysis.

Table 1. Working models

Working model code	Working models	Working model descriptions	References
DNM	Digital nomad model	Employees work from different parts of the world, constantly changing locations. Geographic flexibility is at the forefront of this model.	17,18
HW	Hybrid work	Employees work from the office on certain days of the week and remotely on certain days.	14,15
FW	Flexible work	Employees determine their working hours and are required to complete their work within a certain period of time.	21-23
SW	Shift work	Employees work in rotation at different time zones of the day. It is frequently applied in sectors that require 24/7 service, such as healthcare.	19,20
FRW	Full-time remote work	Employees conduct all of their work remotely, usually from their homes or other locations.	16
PPBW	Part-time-project based work	Employees work on a limited basis for specific projects or periods, unlike a full-time job.	24
FOW	Full-time office work	Employees work full-time in the company's physical office during certain working hours.	12,13

Table 2. Criteria affecting working models

Criteria code	Criteria	Criteria descriptions	References
CO	Cost	Low costs in insurance companies are critical for efficient use of resources and sustainable profitability. Low-cost business models increase the company's competitiveness and reduce financial risks.	34,35
EP	Employee productivity	Employee performance in insurance companies is of critical importance in terms of service quality and the effectiveness of operational processes. Working models that increase employee productivity contribute to faster responses to customer demands by optimizing business processes.	27,28
DS	Data security	Data breaches seriously damage the company's reputation and customer trust. Secure working models ensure that customer information is protected against cyber-attacks and data leaks.	32,33
CS	Customer satisfaction	It is an indicator of the quality of the services provided by insurance companies and the extent to which they meet customer expectations. Models with high customer satisfaction provide advantages in terms of customer loyalty and long-term success.	25,26
TCC	Team communication and collaboration	In companies that adopt a good communication model, the flow of information accelerates, errors are reduced and customer demands are met more efficiently. Working models that strengthen cooperation also enable more successful interventions in times of crisis.	36,37
WLB	Work-life balance	Working models that protect employees' work-life balance prevent burnout syndrome and increase employee loyalty in the long term.	29-31
BCCM	Business continuity and crisis management	Providing uninterrupted service, especially in health insurance services, during crises plays a critical role in preventing customer losses.	38,39

Table 3. Expert details

Experts	Area of expertise	Education level	Title	Experience (years)
E1	Health management	PhD.	Assoc. Prof.	14
E2	Occupational health and safety	Master	Expert	12
E3	Management and strategy	PhD.	Prof. Dr.	20
E4	Banking and insurance	PhD.	Prof. Dr.	17
E5	Business	PhD.	Prof. Dr.	22

Analytical Hierarchy Process

The AHP is a structured decision-making methodology widely used in various fields, including management, engineering, and education, to facilitate complex decision-making by breaking a problem into a hierarchy of subproblems that can be analyzed independently (45,46). AHP allows decision makers to systematically evaluate multiple criteria and alternatives, allowing them to prioritize options according to their relative importance (45). The AHP methodology includes the following steps (47);

Problem Definition and Hierarchical Structuring: The first stage involves clearly defining the decision problem and structuring it into a hierarchy. The decision problem is typically structured into a hierarchy with the main objective at the top, followed by the criteria and subcriteria, and finally the alternatives at the bottom.

Pairwise Comparisons: Decision makers make pairwise comparisons between criteria and alternatives. Each element is compared to all other elements in terms of its contribution to the goal. This is done using a relative importance scale 1 (equal importance) - 9 (extreme importance) that allows for the quantification of subjective judgments.

Calculating Weights and Consistency Ratio: The results of the pairwise comparisons are used to calculate the weights of each criterion and alternative. A consistency ratio (CR) is calculated to ensure that the decisions made are consistent. This can be done using various methods such as the eigenvector method or linear programming approaches.

Synthesizing the Results: Finally, the weighted scores of the alternatives are added to determine the overall ranking. This synthesis provides a clear indication of which alternative is preferred according to the established criteria.

Complex Proportional Assessment

COPRAS is one of the MCDM methods that provide a systematic and effective framework for evaluating alternatives and making informed choices in complex decision-making scenarios (48). One of its most basic features is that it gradually ranks alternatives according to their importance and benefit. It compares alternatives with each other and reveals how much better or worse they are than other alternatives as a percentage (49). The COPRAS method steps can be expressed as follows (49).

Creation of the decision matrix: The decision matrix is created from the x_{ij} values. The criteria are in the row section, and the alternatives are in the column section (Equality 1).

$$D = \begin{vmatrix} X_{11} & \dots & X_{1n} \\ . & . & . \\ X_{m1} & \dots & X_{mn} \end{vmatrix} \quad \text{(Equality 1)}$$

Creating the normalized decision matrix: The normalized decision matrix is determined using Equality (2).

$$x_{ij}^{*} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}, \quad \forall j = 1,2,3,\dots,n \quad \text{(Equality 2)}$$

Creation of weighted decision matrix: Weighted normalized decision matrix is created with Equality (3). Here, d_{ij} is the weighted value, w_j is the criterion weight. Criterion weights are obtained by AHP method.

$$D' = d_{ij} = x_{ij}^{*} \cdot w_j \quad \text{(Equality 3)}$$

Calculation of the optimality function value (benefit-cost): High (max) desired criteria are expressed as "benefit"; low (min) desired criteria are expressed as "cost". The sum of the values in the weighted normalized decision matrix for benefit and cost criteria is calculated using Equality (4) and Equality (5), respectively.

$$S_i^{+} = \sum_{j=1}^{k} d_{ij}, \quad j = 1,2,3,\dots,k \text{ benefit criteria} \quad \text{(Equality 4)}$$

$$S_i^{-} = \sum_{j=k+1}^{n} d_{ij}, \quad j = k+1, k+2, k+3, \dots, n \text{ cost criteria} \quad \text{(Equality 5)}$$

Calculating the relative importance of alternatives: The relative importance value (Q_i) is calculated for alternatives with Equality (6). The highest Q_i value obtained represents the best alternative.

$$Q_i = \frac{S_i^{+}}{\sum_{i=1}^{m} S_i^{-}} \cdot S_i^{-} \cdot \sum_{i=1}^{m} \frac{1}{S_i^{-}} \quad \text{(Equality 6)}$$

Determining the highest relative importance: The one with the largest value among the relative priority values is calculated (Equality 7).

$$Q_{\max} = \max\{Q_i\}, \quad \forall i = 1,2,3,\dots,n \quad \text{(Equality 7)}$$

Determining the benefit levels of alternatives: The performance index (P_i) is calculated for each alternative using Equality (8).

$$P_i = \frac{Q_i}{Q_{\text{maks}}} \cdot 100\ (\backslash\%) \qquad \text{(Equality 8)}$$

Ethical Aspects of Research and Consent

The scientific applicability of the research was approved by the Non-Interventional Clinical Research Ethics Committee of a İstanbul Medipol University (decision no: 292, date: 06.03.2025). In addition, experts were informed about the study and signed an informed consent form.

Results

For the criteria affecting the study models, pairwise comparison matrices were obtained by collecting opinions from experts through AHP questionnaires. The integrated decision matrix was determined by taking the geometric averages of the values in the comparison matrices containing the opinions of all experts (Table 4).

The column totals of the values in the integrated decision matrix were taken, and each value was divided by the column total to create a normalized matrix. Then, the row averages of the normalized matrix values were taken to determine the eigenvector (weight) values of the criteria (Table 5).

To calculate the CR, the integrated decision matrix values were multiplied by the eigenvector values, the row sums were taken, and the eigenvalue scores were found. The average CR was found to be 0.071. Criteria weights and rankings are given in Table 6.

According to Table 6, the most important criterion to be used in the evaluation of the working models of health insurance companies was found to be cost with a normalized weight score of 23.04%. This was followed by CS (20.38%) and employee productivity (18.84%). Business continuity and crisis management was determined as the least important criterion with a weight of 7.50%.

According to the method, the benefit criterion indicates that higher values indicate a better situation in reaching the goal. The cost criterion represents that lower values indicate a better situation in reaching the goal. In this direction, the maximization of all criteria except cost in the study is a benefit. The high value of these criteria has a positive effect on the alternative selection. A survey form was prepared according to the 5-point Likert scale by considering the 7 criteria in Table 6 for the working models in Table 1. This survey form was evaluated by 5 experts whose details are shown in Table 3.

The decision matrix created by averaging the expert evaluations is shown in Table 7.

The normalized decision matrix was obtained using Equation (2) (Table 8).

Table 4. AHP integrated decision matrix

	CO	EP	DS	CS	TCC	WLB	BCCM
CO	1.00	1.00	5.20	1.00	3.12	2.00	2.00
EP	1.00	1.00	3.00	1.00	1.55	2.50	1.20
DS	0.20	0.33	1.00	0.50	2.50	1.00	3.00
CS	1.00	1.00	2.00	1.00	3.00	2.00	3.00
TCC	0.33	0.67	0.40	0.33	1.00	0.67	2.00
WLB	0.50	0.40	1.00	0.50	1.50	1.00	2.00
BCCM	0.50	0.83	0.33	0.33	0.50	0.50	1.00
Total	4.53	5.23	12.93	4.66	13.17	9.67	14.20

AHP: Analytical hierarchy process, CO: Cost, EP: Employee productivity, DS: Data security, CS: Customer satisfaction, TCC: Team communication and collaboration, WLB: Work-life balance, BCCM: Business continuity and crisis management

Table 5. AHP normalized matrix

	CO	EP	DS	CS	TCC	WLB	BCCM	Eigenvector (weight)
CO	0.22	0.19	0.40	0.21	0.24	0.21	0.14	0.2304
EP	0.22	0.19	0.23	0.21	0.12	0.26	0.08	0.1884
DS	0.04	0.06	0.08	0.11	0.19	0.10	0.21	0.1137
CS	0.22	0.19	0.15	0.21	0.23	0.21	0.21	0.2038
TCC	0.07	0.13	0.03	0.07	0.08	0.07	0.14	0.0841
WLB	0.11	0.08	0.08	0.11	0.11	0.10	0.14	0.1042
BCCM	0.11	0.16	0.03	0.07	0.04	0.05	0.07	0.0750

AHP: Analytical hierarchy process, CO: Cost, EP: Employee productivity, DS: Data security, CS: Customer satisfaction, TCC: Team communication and collaboration, WLB: Work-life balance, BCCM: Business continuity and crisis management

Table 6. AHP criteria weights and rankings

Criteria code	Criteria	Eigenvector (weight)	Ranking
CO	Cost	0.2304	1
CS	Customer satisfaction	0.2038	2
EP	Employee productivity	0.1884	3
DS	Data security	0.1137	4
WLB	Work-life balance	0.1042	5
TCC	Team communication and collaboration	0.0841	6
BCCM	Business continuity and crisis management	0.0750	7

AHP: Analytical hierarchy process

Table 7: COPRAS decision matrix

Working models	Criteria code						
	CO	EP	DS	CS	TCC	WLB	BCCM
DNM	4.8	2.8	2.4	4.8	3.0	3.8	4.0
HW	3.8	4.8	4.8	4.2	4.2	4.8	3.8
FW	2.2	3.8	2.8	3.0	3.6	2.8	3.2
SW	2.4	2.8	2.2	1.2	3.6	1.2	1.6
FRW	3.8	2.8	3.0	3.0	2.8	1.8	2.2
PPBW	3.8	4.8	3.8	3.2	4.0	2.2	2.2
FOW	3.8	4.2	2.8	2.8	2.8	3.8	3.2
Total	24.6	26	21.8	22.2	24	20.4	20.2

COPRAS: Complex proportional assessment, DNM: Digital nomad model, HW: Hybrid work, FW: Flexible work, SW: Shift work, FRW: Full-time remote work, PPBW: Part-time-project based work, FOW: Full-time office work, CO: Cost, EP: Employee productivity, DS: Data security, CS: Customer satisfaction, TCC: Team communication and collaboration, WLB: Work-life balance, BCCM: Business continuity and crisis management

Table 8. COPRAS normalized matrix

	Criteria						
	Min.	Max.	Max.	Max.	Max.	Max.	Max.
Weights	0.2304	0.1884	0.1137	0.2038	0.0841	0.1042	0.0750
Working models	**CO**	**EP**	**DS**	**CS**	**TCC**	**WLB**	**BCCM**
DNM	0.1951	0.1076	0.1100	0.2162	0.1250	0.1862	0.1980
HW	0.1544	0.1846	0.2201	0.1891	0.1750	0.2352	0.1881
FW	0.0894	0.1461	0.1284	0.1351	0.1500	0.1372	0.1584
SW	0.0975	0.1076	0.1009	0.0540	0.1500	0.0588	0.0792
FRW	0.1544	0.1076	0.1376	0.1351	0.1166	0.0882	0.1089
PPBW	0.1544	0.1846	0.1743	0.1441	0.1666	0.1078	0.1089
FOW	0.1544	0.1615	0.1284	0.1261	0.1166	0.1862	0.1584

COPRAS: Complex proportional assessment, DNM: Digital nomad model, HW: Hybrid work, FW: Flexible work, SW: Shift work, FRW: Full-time remote work, PPBW: Part-time-project based work, FOW: Full-time office work, CO: Cost, EP: Employee productivity, DS: Data security, CS: Customer satisfaction, TCC: Team communication and collaboration, WLB: Work-life balance, BCCM: Business continuity and crisis management

Equality (3) was applied using the criterion weights obtained as a result of the AHP analysis, and a weighted normalized matrix was created (Table 9).

The values of for benefit criteria and for cost criteria were determined using Equations (4) and (5). The relative importance values (Q_i) for each study model were calculated using Equation (6). In the next stage, the highest relative importance Q_{max} and the benefit degrees (P_i) of the study models were determined using Equations (7) and (8) and the final rankings were made (Table 10).

According to Table 10; hybrid work with a performance index of 100%, symbolized as is the most beneficial working model. Flexible work with a performance index of 87.47% and part-time-project-based work with a performance index of 80.95% are also among the most common models. The least beneficial working model was determined as SW with a performance index value of 62.43%.

Table 9. COPRAS weighted normalized matrix

Working models	Criteria no						
	CO	EP	DS	CS	TCC	WLB	BCCM
DNM	0.0449	0.0202	0.0125	0.0440	0.0105	0.0194	0.0148
HW	0.0356	0.0347	0.0250	0.0385	0.0147	0.0245	0.0141
FW	0.0206	0.0275	0.0146	0.0275	0.0126	0.0143	0.0118
SW	0.0224	0.0202	0.0114	0.0110	0.0126	0.0061	0.0059
FRW	0.0356	0.0202	0.0156	0.0275	0.0098	0.0091	0.0081
PPBW	0.0356	0.0347	0.0198	0.0293	0.0140	0.0112	0.0081
FOW	0.0356	0.0304	0.0146	0.0257	0.0098	0.0194	0.0118

COPRAS: Complex proportional assessment, DNM: Digital nomad model, HW: Hybrid work, FW: Flexible work, SW: Shift work, FRW: Full-time remote work, PPBW: Part-time-project based work, FOW: Full-time office work, CO: Cost, EP: Employee productivity, DS: Data security, CS: Customer satisfaction, TCC: Team communication and collaboration, WLB: Work-life balance, BCCM: Business continuity and crisis management

Table 10. Importance values and final ranking for working models

Working Models	S_i^+	S_i^-	Q_i	P_i	Ranking
DNM	0.1216	0.0449	0.1442	80.019	4
HW	0.1517	0.0356	0.1802	100	1
FW	0.1085	0.0206	0.1576	87.47	2
SW	0.0674	0.0224	0.1125	62.43	7
FRW	0.0906	0.0356	0.1191	66.10	6
PPBW	0.1174	0.0356	0.1458	80.95	3
FOW	0.1118	0.0356	0.1403	77.86	5

DNM: Digital nomad model, HW: Hybrid work, FW: Flexible work, SW: Shift work, FRW: Full-time remote work, PPBW: Part-time-project based work, FOW: Full-time office work

Discussion

Within the scope of the study, the most beneficial working models for health insurance companies were determined as hybrid working, flexible working and, part-time-project-based working, respectively.

When the hybrid working model with the highest performance index (100%) is examined, there are studies in the literature that support this opinion. Khatatbeh et al. (50) emphasized in their study that the hybrid working model would reduce burnout and increase job satisfaction by encouraging a better balance between personal and professional lives. Similarly, Siddika (51) stated in his study that the implementation of the hybrid working model during the COVID-19 outbreak enabled employees to re-evaluate their work-life balance and achieve better health outcomes and productivity as a result of the commute-related stress reduction. Buick et al. (52) stated in their study that with the transition to hybrid structures, resource use would be optimized, and companies could reduce costs associated with physical office spaces by offering more flexible working options. Indeed, Kajwang (53) pointed out that as job seekers increasingly prioritized work-life balance and health benefits in their employment decisions, the flexibility provided by hybrid models would lead to higher employee retention and lower recruitment costs for health insurers.

The working model with the second-highest performance index (87.47%) is flexible working. Menezes and Kelliher (54) emphasized that flexible working not only increased job satisfaction but also contributed positively to individual performance by meeting employees' needs for autonomy and work-life integration. Timms et al. (55) also emphasized the positive relationship between flexible working and the reduction of chronic stress, stating that flexible working was an important step in promoting a healthier and more productive workforce. Similarly, Ghali-Zinoubi et al. (56) emphasized that flexible working hours contributed to the reduction of work-life conflict and significantly increased employee satisfaction by allowing individuals to better manage their professional and personal lives.

The third highest performance index (80.95%) was found to be part-time project-based work. When looking at the studies in the literature, Zeng et al. (57) argued that project-based companies optimized resource management and increased their ability to respond quickly to market changes by aligning their workforce with project demands. They also stated that this situation provided a significant competitive advantage in the sector. Similarly, Aziz et al. (58) revealed the prevalence of adopting part-time project work models, especially during periods of uncertainty such as economic recession or epidemics, and stated that the flexibility offered by project-based employment structures allowed organizations to maintain operational continuity even in turbulent times and to adapt more easily to the potential risks of

subsequent crises. Similarly, Suryanto et al. (59) and Kimani and Kungu (60) argued in their studies that the dynamic nature of competition in the market required insurers to adopt innovative business development strategies that were effectively executed through project-based methodologies.

The findings of this study are open to evaluation with different theoretical frameworks. The trend towards hybrid and flexible working models in health insurance companies shows that companies adapt their structures and processes in response to environmental and technological changes. This situation overlaps with the organizational change theory (3). The determination of cost and CS as the most prioritized evaluation criteria intersects with the need for organizations to balance operational efficiency with service quality to maintain their competitive advantage in strategic management theory (5). On the other hand, the emphasis on data security and technological infrastructure, which constitute the basic dynamics of modern working models, can be associated with the implications of the digital transformation theory (7,8). Integrating these theoretical perspectives not only provides a deeper understanding of the empirical results but also enhances the practical implications of the study for strategic decision-making in health insurance companies.

Study Limitations

This study has several limitations that should be acknowledged. The criteria affecting the study models were obtained through a literature review. These criteria can be created based on qualitative data collection methods, such as in-depth interviews with experts and focus group discussions. The inclusion of additional or alternative criteria could influence the outcomes. Moreover, the evaluations were conducted in a cross-sectional manner, meaning that they did not account for dynamic changes in organizational needs, workforce preferences, or technological developments over time. Secondly, for the AHP and COPRAS methods, five experts from specific fields were consulted. Although these individuals were selected for their expertise, representativeness could be increased by adding opinions from participants from different fields.

Conclusion

Working models with different advantages and disadvantages can be applied in business processes for health insurance companies. It has been determined within the scope of the study that the most beneficial working model is hybrid working. The implementation of both remote and face-to-face working options can provide the opportunity to tap into a broader talent pool, including individuals who may face geographical or transportation restrictions and potential employees for health insurance companies. This model also allows employees to save time and transportation costs, increases work-life balance, and contributes to employee satisfaction. For days when working remotely, distractions in the office environment can be removed, and a more focused working order can be created. Expenses such as energy, transportation, and office supplies decrease. This situation also contributes to the sustainability goals of companies by reducing carbon emissions from transportation. It allows business continuity to be ensured, and a rapid transition to remote working can be made in crisis and extraordinary situations (pandemic, natural disasters, etc.). The applicability of this model also brings with it a strong technological infrastructure that supports remote working. The use of tools such as cloud-based systems, virtual private network solutions, video conferencing tools, and project management software should be integrated into the process. In addition, as in every representative of the health sector, the protection of personal data is a matter of particular importance in health insurance companies. In this regard, cybersecurity measures must be increased more than ever. In order to provide a more productive environment on days when working in the office, work areas should be optimized, and rearrangements such as open office areas or quiet study rooms should be made. In addition, it is recommended that managers be trained on remote team management and communication skills in terms of measuring and monitoring staff performance.

On the other hand, the flexible working model allows employees to work during the periods when they are most productive. For this reason, an evaluation system that focuses on work output rather than working hours should be established. In this model, trust in the time management and self-discipline skills of employees is essential. In this direction, employees should be given training to increase their skills in time management and motivation. Automatic call forwarding systems and digital assistants should definitely be put into operation so that flexible remote employees can respond quickly to customer demands. Working conditions from home should be improved by providing digital office support.

Finally, part-time project-based employees are more cost-effective than full-time employees. This model offers a cost-efficient solution for insurance companies operating under limited project budgets. The quality and efficiency of project outputs also increase as it ensures that employees with a specific area of expertise are included in the project. It also provides scalability of workload for insurance companies. When project intensity increases, more employees can be hired, and when it decreases, the number of employees can be reduced. Indeed, when the project is completed, the employment relationship of the employees ends, which reduces long-term costs. For this model, employees' data security policies can be clearly defined, and an authorized access model can be created. It should be clearly stated which tasks employees should complete and when, and job analyses should be performed. Online project management platforms should be used for effective management of teams, and project-based progress payment systems should be put into effect.

In this context, it is important for health insurance companies to first analyze their business processes and determine which model is more suitable for which department or task. By blending these models with a strategic approach, companies can both increase employee satisfaction and ensure operational efficiency. In this way, it will be easier for them to achieve long-term growth and sustainability goals. While the results offer valuable insights into

working model prioritization, the applicability of the findings may vary in other countries depending on regulatory, cultural, and economic factors. Future studies can expand this research by comparing health insurance companies across different national contexts.

Ethics

Ethics Committee Approval: The scientific applicability of the research was approved by the Non-Interventional Clinical Research Ethics Committee of a İstanbul Medipol University (decision no: 292, date: 06.03.2025).

Informed Consent: Experts were informed about the study and signed an informed consent form.

Footnotes

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Original Article

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Academic Productivity and Trends in Anesthesia Research in Türkiye: A Bibliometric Perspective (1981-2024)

Anestezi Araştırmalarında Akademik Verimlilik ve Yönelimler: Türkiye'den Bir Bibliyometrik Perspektif (1981-2024)

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ABSTRACT

Objective: The field of anesthesiology in Türkiye has witnessed a significant increase in academic productivity over the past decades. Bibliometric analyses provide a quantitative evaluation of research output, publication trends, and emerging topics in a specific discipline. This study aims to conduct a comprehensive bibliometric analysis of anesthesiology publications in Türkiye from 1981 to 2024.

Methods: Data were retrieved from the Web of Science Core Collection, focusing on publications indexed in the Science Citation Index Expanded and Emerging Sources Citation Index. The search was conducted using the terms "anesthesia" or "anaesthesia" under the anesthesiology category. The analysis included 2,768 publications, consisting of original articles, letters, reviews, and editorial materials. Performance analysis, keyword co-occurrence mapping, citation analysis, and trend topic identification were conducted using VOSviewer and SPSS. Predictive modeling estimated the projected publication trends over the next five years.

Results: The number of anesthesiology-related publications in Türkiye has steadily increased, with open-access publications accounting for 42.63% of the total. Regional anesthesia, postoperative pain management, and multimodal analgesia emerged as dominant research topics in cluster analyses. İstanbul University ranked first in publication output (19%), reflecting the impact of

ÖZ

Amaç: Türkiye'de anesteziyoloji alanı son yıllarda akademik üretkenlikte önemli bir artışa tanık olmuştur. Bibliyometrik analizler, belirli bir disiplindeki araştırma çıktısının, yayın eğilimlerinin ve yeni ortaya çıkan konuların nicel bir değerlendirmesini sağlar. Bu çalışmanın amacı, 1981-2024 yılları arasında Türkiye'deki anesteziyoloji yayınlarının kapsamlı bir bibliyometrik analizini yapmaktır.

Yöntemler: Veriler Web of Science Core Collection'dan alınmış, Science Citation Index Expanded ve Emerging Sources Citation Index indekslerinde taranan yayınlara odaklanılmıştır. Arama, anesteziyoloji kategorisi altında "anesthesia" veya "anaesthesia" terimleri kullanılarak gerçekleştirilmiştir. Analize orijinal makaleler, mektuplar, derlemeler ve editöryal materyallerden oluşan 2,768 yayın dahil edilmiştir. Performans analizi, anahtar kelime eş-oluşum haritalaması, atıf analizi ve trend konu tanımlaması VOSviewer ve SPSS kullanılarak gerçekleştirilmiştir. Tahmine dayalı modelleme, önümüzdeki beş yıl içinde öngörülen yayın eğilimlerini tahmin etmiştir.

Bulgular: Türkiye'de anesteziyoloji ile ilgili yayınların sayısı istikrarlı bir şekilde artmıştır ve açık erişimli yayınlar toplamın %42,63'ünü oluşturmaktadır. Bölgesel anestezi, postoperatif ağrı yönetimi ve multimodal analjezi, küme analizlerinde baskın araştırma konuları olarak ortaya çıkmıştır. İstanbul Üniversitesi,

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ABSTRACT

institutional history on scientific contributions. Statistical analyses demonstrated a significant positive correlation between faculty age and publication volume (r=0.659, p=0.008). Predictive modeling suggested continued growth in research output.

Conclusion: This bibliometric analysis highlights Türkiye's increasing contribution to global anesthesiology research, with growing interest in perioperative pain management and regional anesthesia techniques. The findings offer valuable insights for academics and funding agencies to shape future research priorities and foster international collaboration.

Keywords: Anesthesia, anesthesiology, bibliometric analysis, VOSviewer, citation analysis

ÖZ

kurumsal tarihin bilimsel katkılar üzerindeki etkisini yansıtan yayın çıktısında (%19) ilk sırada yer almıştır. İstatistiksel analizler, fakülte yaşı ile yayın hacmi arasında anlamlı bir pozitif korelasyon olduğunu göstermiştir (r=0,659, p=0,008). Tahmine dayalı modelleme, araştırma çıktılarındaki büyümenin devam edeceğini göstermiştir.

Sonuç: Bu bibliyometrik analiz, perioperatif ağrı yönetimi ve rejyonal anestezi tekniklerine artan ilgiyle birlikte Türkiye'nin küresel anesteziyoloji araştırmalarına artan katkısını vurgulamaktadır. Bulgular, gelecekteki araştırma önceliklerini şekillendirmek ve uluslararası işbirliğini teşvik etmek için akademisyenler ve fon sağlayan kuruluşlar için değerli bilgiler sunmaktadır.

Anahtar Kelimeler: Anestezi, anesteziyoloji, bibliyometrik analiz, VOSviewer, atıf analizi

Introduction

In recent years, academic productivity and publication activities in the field of anesthesiology in Türkiye have increased in both quantity and diversity. Similar to other medical disciplines, academics in anesthesiology publish scientific studies to establish scientific communication with colleagues, share research findings, and present new ideas (1). Regardless of the purpose, every academic publication contributes to the existing literature, leaving a lasting impact.

Various associations and organizations related to anesthesia undertake initiatives to advance anesthesiology and foster its academic growth (2). These efforts strengthen the foundation of scientific publishing, support the dissemination of innovations, and contribute to the production of new research. Additionally, they help identify "outdated" methods and knowledge, enabling the development of novel and innovative approaches (3).

Numerous shared databases have been established to facilitate the dissemination of scientific publications. These databases facilitate shared access to scientific publications across countries and institutions, enhancing accessibility and promoting collaboration. However, the increasing volume of publications within these databases presents challenges for academics in conducting targeted searches and efficiently accessing relevant sources. Although various databases have been established and keyword-based searches are possible, reaching key publications can still be difficult at times (4).

Bibliometric analyses can serve as a guiding tool for academics in this regard. These analyses focus on statistically examining publications within a specific scientific field and time frame, as well as the relationships between them (5). By utilizing bibliometric methods, researchers can gain insights into current trends and future research directions through keyword analysis. Furthermore, bibliometrics helps identify emerging trends in a given field, enabling authors to better understand and align with existing and prospective research trajectories (6,7).

Anesthesiology is a multidisciplinary field that encompasses anesthesia management along with the subspecialties of pain medicine and critical care, making it a highly comprehensive discipline. Consequently, the volume of data within relevant databases is substantial. This study aims to systematically analyze anesthesiology research contributions from Türkiye to the global literature, highlight key aspects, and provide insights for academics to guide future research directions. This study presents a comprehensive bibliometric analysis of anesthesia-related publications from Türkiye between 1981 and 2024. By utilizing data from the Web of Science (WoS) Core Collection, the research systematically examines publication trends, citation impact, institutional contributions, and thematic developments in the field. The analysis employs bibliometric mapping techniques such as keyword co-occurrence, citation network analysis, and trend analysis to identify key research areas and evolving scientific interests. The main aim is to provide an in-depth evaluation of Türkiye's academic output in anesthesiology, highlighting its contributions to global literature while offering insights into emerging research trends. This study also can serve as a valuable resource for researchers and academic institutions in shaping future research strategies and fostering scientific collaboration in the field of anesthesiology.

Methods

Ethics Statement

As this study is a bibliometric analysis based on published literature, ethics committee approval was not required. Information has been provided to the ethics committee only through an official letter.

Study Design

This is a bibliometric study that systematically analyzes publications in the field of anesthesiology to identify research trends, active institutions and conceptual structures. The study employs performance analysis and science mapping techniques to evaluate the evolution of research themes and contributions to the field.

Data Source and Search Strategy

Data were retrieved from the WoS Core Collection (WoS by Clarivate Analytics), with a focus on publications indexed in the Science Citation Index Expanded (SCIE) and Emerging Sources Citation Index (ESCI). The search was conducted on December 6, 2024, and included articles published between 1981 and 2024. The search terms used were "anesthesia" or "anaesthesia", and the results were filtered to include only studies affiliated with institutions in Türkiye or Turkey under the ANESTHESIOLOGY category.

A total of 2,819 publications were identified. After excluding 51 publications categorized as proceedings papers and other document types such as meeting abstracts, book chapters, retracted articles, corrections, and discussion notes, a total of 2,768 documents (original articles, letters, reviews, and editorial materials) were included in the final analysis.

The WoS Core Collection (SCIE and ESCI) was selected as the sole data source due to its rigorous journal inclusion standards, peer-reviewed and curated content, and structured metadata that is compatible with advanced bibliometric tools. Although databases such as Scopus offer broader journal coverage, previous research has demonstrated that bibliometric indicators obtained from WoS and Scopus are highly correlated at the national and disciplinary levels (8). Using a single consistent data source minimizes heterogeneity and enhances the reproducibility and internal consistency of the analysis.

Statistical Analysis

The bibliometric analysis involved several key methodologies. Performance analysis was conducted to evaluate the number of publications per year, document types, and citation metrics.

To explore relationships within the dataset, science mapping techniques such as keyword co-occurrence and citation network analyses were performed using VOSviewer (version 1.6.18, Leiden University, Netherlands). Trend topic analysis was utilized to examine the evolution of research themes over different time periods in anesthesiology. Furthermore, institutional contributions were assessed by identifying the most active institutions based on publication count and citation impact. Cluster analysis was conducted on keyword networks to identify major research clusters and thematic developments. Additionally, a co-citation analysis was performed to determine the most influential articles and journals within the dataset.

To ensure the consistency and reliability of the dataset, duplicate records were identified and removed using DOI matching and title-author similarity. Early access and final-version duplicates were carefully screened. Institutional names were standardized manually for high-frequency organizations to merge known variants (e.g., abbreviation vs. full name, Turkish vs. English spelling). Additionally, VOSviewer's thesaurus file was applied to unify author and affiliation name variants during network visualizations.

Additionally, statistical analyses were conducted using SPSS (version 29.0, IBM, Chicago, IL, USA), including descriptive statistics, regression and correlation analyses to evaluate trends within the dataset. SPSS was also utilized for predictive modeling to estimate the number of publications expected over the next five years based on historical trends.

Results

In the literature reviewed, the data of the articles included in the study are given in the flow chart (Figure 1).

As a result of a comprehensive literature review, a total of 2,819 publications on anesthesia were identified in the WoS Core Collection (SCI and ESCI) between 1981 and 2024 (Table 1).

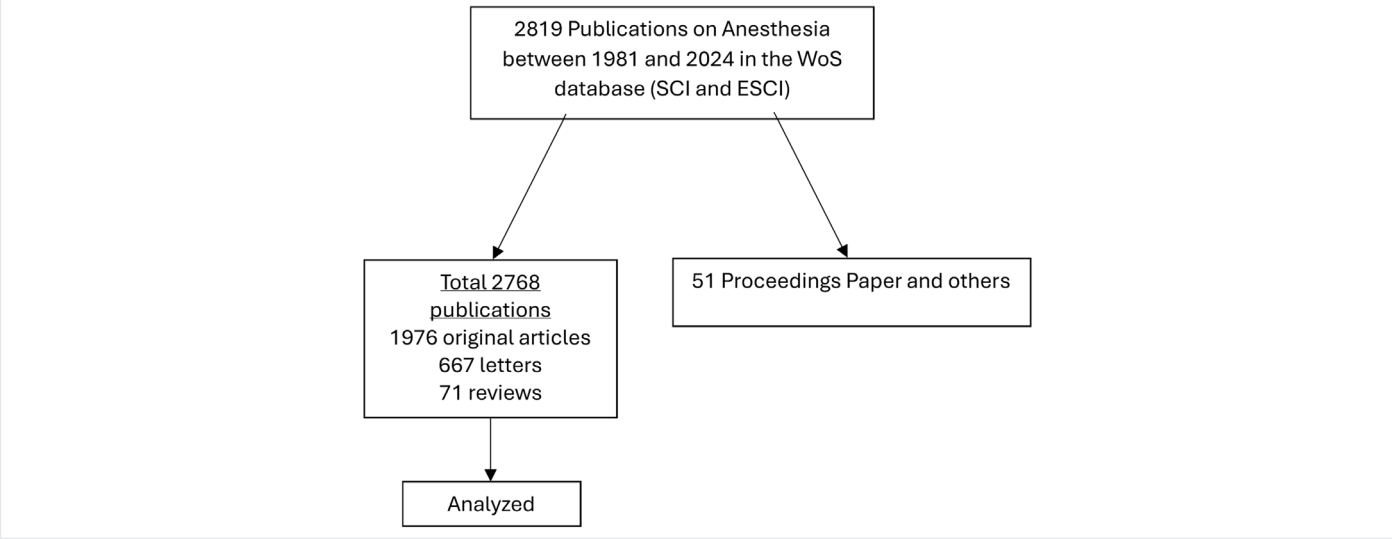

Figure 1. Flow chart of the bibliometric analysis
ESCI: Emerging Sources Citation Index

Among the 2,768 publications, 71.39% (n=1,976) were articles, 24.10% (n=667) letters, 2.57% (n=71) reviews, and 1.95% (n=54) editorial materials. The total number of citations for all document types was 36,280, with an average citation per document of 13.11 (Table 2).

In terms of indexing, 78.68% (n=2,178) of the publications were indexed in the SCIE, while 21.32% (n=590) were in the ESCI. The citation count in the SCIE index was 34,154 (15.68 citations/document), whereas ESCI-indexed papers had 2,126 citations (3.60 citations/document) (Table 3).

Among the 2,768 analyzed publications, 42.63% (n=1,299) were published as open access, reflecting the global trend toward wider dissemination of scientific knowledge.

The Gold Open Access category, which includes fully open-access journals, accounted for 19.53% (n=595) of the publications. A smaller portion of publications, 0.66% (n=20), was classified as Gold-Hybrid Open Access, indicating articles made openly accessible within subscription-based journals. Additionally, 18.18% (n=554) of the publications were categorized as Free to Read, referring to articles made available without paywall restrictions, though not necessarily published under open-access policies. The Green Open Access model, which allows authors to share versions of their work through institutional repositories, accounted for 19.00% (n=579) of the publications. In the Clarivate classification, OA subcategories may overlap; therefore, their subtotals should not be arithmetically summed with the "All Open Access" category (Table 4).

The bibliometric analysis of 2,768 anesthesia-related publications identified the most active journals contributing to the field. These journals vary in terms of quartile ranking (Q1-Q4), citation impact, and research focus, reflecting their influence on the dissemination of anesthesia research (Table 5). Among the leading journals, Q1-ranked journals accounted for a significant proportion of high-impact publications. The Journal of Clinical Anesthesia (Q1, n=339) was the most frequently used journal, accumulating 4,797 citations, with an average of 14.15 citations per document. Other notable Q1-ranked journals included Anesthesia & Analgesia (n=188, 4,617 citations, avg. 24.56 citations/document) and the European Journal of Anaesthesiology (n=179, 3,539 citations, avg. 19.77 citations/document). Q2-ranked journals, including Pediatric Anesthesia (n=204, 2,586 citations, avg. 12.68 citations/document) and the Journal of Cardiothoracic and Vascular Anesthesia (n=164, 2,419 citations, avg. 14.75 citations/document), also played a substantial role in anesthesia research dissemination. The Turkish Journal of Anaesthesiology and Reanimation (Q3, n=298) was among the most frequently used journals in the dataset, though its average citation per document (3.62 citations) was lower compared to high-impact international journals. A notable contribution from Q4-ranked journals was observed, particularly in Revista Brasileira de Anestesiologia (n=161, 1,242 citations, avg. 7.71 citations/document), reflecting its regional importance in anesthesia research. Collectively, the top 10 journals accounted for 1,889 publications (66.91% of the total), accumulating 25,0509 citations. The remaining 54 journals collectively published 916 publications, receiving 11,221 citations (avg. 12.25 citations/document).

The analysis of anesthesia-related publications revealed that 15 research universities with medical faculties played a significant role in the scientific output of Türkiye. These universities collectively contributed 1,272 publications, representing a substantial share of the total 2,768 analyzed publications (45.96%) (Table 6). Among the leading institutions, İstanbul

Table 1. Types of publications [count/percentage (%)]

Document types	Count	Percentage (%)
Article	1,976	70.10
Letter	667	23.66
Review	71	2.52
Editorial material	54	1.92
Proceedings paper and others	51	1.81
Total	2,819	100

Table 2. Number and citations of the publications [count/percentage (%)]

Document types	Count	Percentage (%)	Citations (WoS)	Citation/count
Article	1,976	71.39	31,945	16.17
Letter	667	24.10	3,098	4.64
Review	71	2.57	1,074	15.13
Editorial material	54	1.95	163	3.02
Total	2,768	100.00	36,280	13.11

WoS: Web of science

Table 3. Citation count and indexing of the publications [number, percentage (%)]

Index	Count	Percentage	Citations (WoS)	Citation/ Count
Science Citation Index Expanded (SCIE)	2,178	78.68	34,154	15.68
Emerging Sources Citation Index (ESCI)	590	21.32	2,126	3.60
Total	2,768	100.00	36,280	13.11

WoS: Web of Science

Table 4. Open Access models of the publications [number, percentage (%)]

Open access	Document count	Percentage
All open access	1,299	42.63
Gold	595	19.53
Gold-hybrid	20	0.66
Free to read	554	18.18
Green published	579	19.00

University (n=236, 19.05%) emerged as the most productive, followed by Atatürk University (n=134, 10.82%), Hacettepe University (n=141, 11.38%), and İstanbul University-Cerrahpaşa (n=124, 10.01%). Other notable contributors included Gazi University (n=107, 8.64%), Çukurova University (n=59, 4.76%), Dokuz Eylül University (n=78, 6.30%), Ege University (n=47, 3.79%), and Marmara University (n=62, 5.00%). Additionally, Koç University (n=32, 2.58%), despite being a relatively newer institution (established in 2009), has established itself as a key player in anesthesia research. In contrast, seven research universities were excluded from the analysis due to the absence of a medical faculty. These included Boğaziçi University, Gebze Technical University, İhsan Doğramacı Bilkent University, İstanbul Technical University, İzmir Institute of Technology, Middle East Technical University, and Sabancı University.

A statistical analysis was conducted to examine the relationship between faculty age and publication count among the 15 research universities included in the study. The Pearson correlation analysis revealed a significant positive correlation (r=0.659, p=0.008), suggesting that as faculty age increases, the number of anesthesia-related publications also tends to rise. A linear regression analysis was performed to further explore this relationship, with faculty age as the independent variable and publication count as the dependent variable. The regression model was statistically significant [F (1,13)=9.958, p=0.008] and explained 43.4% (R^2=0.434) of the variance in publication count. The unstandardized regression coefficient for faculty age was b = 2.125, 95% CI (0.670, 3.580), p = 0.008, indicating that for each additional year in faculty age, the predicted number of publications increases by approximately 2.125 units. The regression equation derived from this model is given by Equation (1)

$$\text{publication count} = -32.312 + (2.125 \times \text{faculty years}) \quad (1)$$

Table 5. Journals with the most publications [number, percentage (%)]

Journals with the most publications (Top 10)	Quartile	Document count	Citation (WoS)	Average citation per document
Journal of Clinical Anesthesia	Q1	339	4,797	14.15
Turkish Journal of Anaesthesiology and Reanimation	Q3	298	1,080	3.62
Pediatric Anesthesia	Q2	204	2,586	12.68
Anesthesia & Analgesia	Q1	188	4,617	24.56
European Journal of Anaesthesiology	Q1	179	3,539	19.77
Journal of Cardiothoracic and Vascular Anesthesia	Q2	164	2,419	14.75
Revista Brasileira de Anestesiologia	Q4	161	1,242	7.71
Journal of Anesthesia	Q2	139	1,727	12.42
Acta Anaesthesiologica Scandinavica	Q2	99	2,221	22.43
Minerva Anestesiologica	Q1	80	831	10.26
Others (54 journals)		916	11,221	12.25
Total		2,768	36,280	13.11

WoS: Web of science

Table 6. Year of establishment and document count [number, percentage (%)]

Name	Year of establishment	Publication count	Percentage
İstanbul University	1933	236	19.05
Hacettepe University	1967	141	11.38
Atatürk University	1957	134	10.82
İstanbul University-Cerrahpaşa	1967	124	10.01
Gazi University	1979	107	8.64
Ankara University	1945	85	6.86
Dokuz Eylül University	1978	78	6.30
Marmara University	1983	62	5.00
Çukurova University	1972	59	4.76
Ege University	1955	47	3.79
Erciyes University	1978	46	3.71
Bursa Uludağ University	1970	37	2.99
Koç University	2009	32	2.58
Karadeniz Technical University	1973	31	2.50
Fırat University	1983	20	1.61

This trend is visually represented in the scatter plot with a fitted regression line, showing a clear upward trajectory in publication count as faculty age increases (Figure 2). İstanbul University, being one of the oldest institutions, had the highest publication output, whereas younger institutions such as Koç University exhibited lower publication numbers.

The estimation model results indicate a steady increase in the number of anesthesia-related publications in the coming years (Figure 3). Based on Holt's linear trend model, the forecasted publication counts for the period 2025-2029 are as follows:

- 2025: 123 publications (95% CI: 66-180)
- 2026: 128 publications (95% CI: 58-198)
- 2027: 133 publications (95% CI: 52-214)
- 2028: 138 publications (95% CI: 47-228)
- 2029: 142 publications (95% CI: 43-242)

A keyword analysis was conducted on the 2,768 anesthesia-related publications, revealing a total of 3,862 distinct keywords used across the dataset. The top 10 most frequently used keywords, each appearing more than 10 times, provide insights into the dominant research themes and trending topics in the field. The most frequently used keyword was "anesthesia" (n=128), followed by "propofol" (n=106), a widely used intravenous anesthetic agent. Postoperative pain (n=80) and postoperative

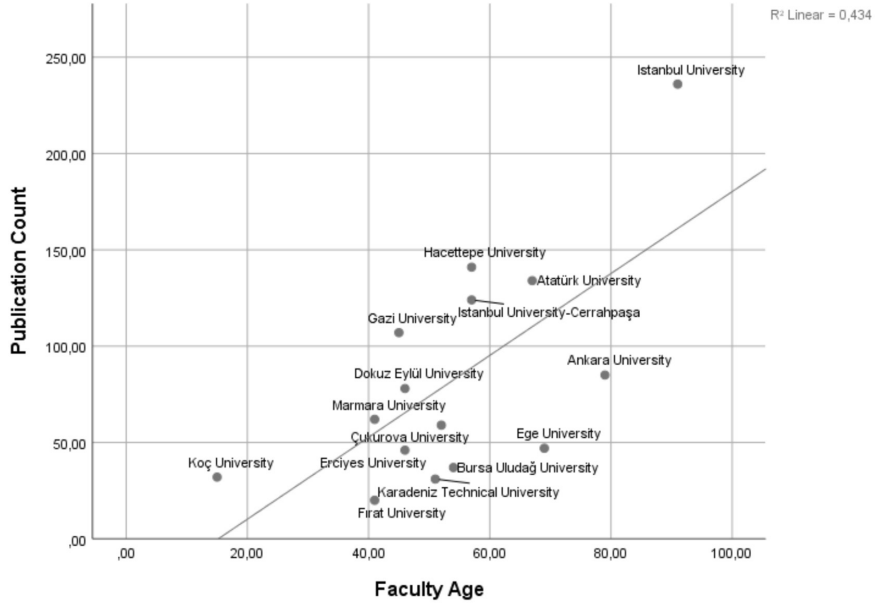

Figure 2. Correlation of faculty age and publication count

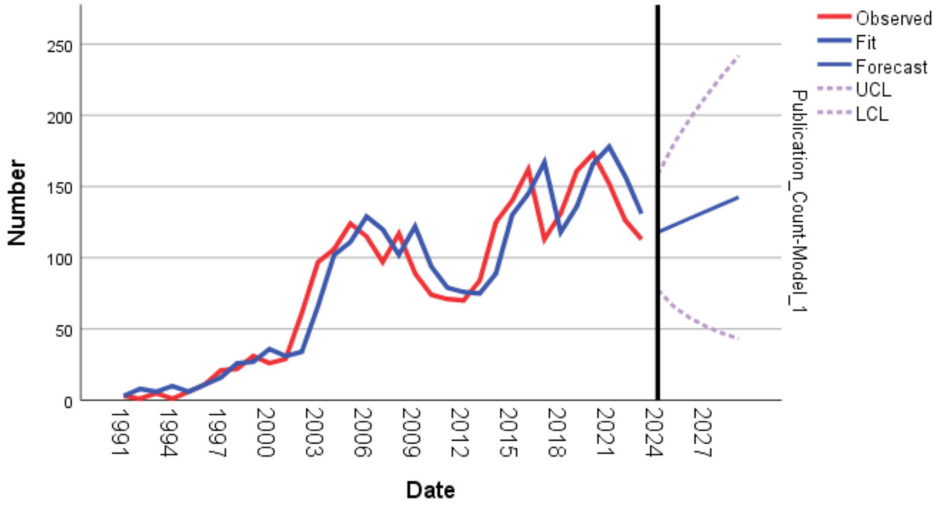

Figure 3. The estimation of number of anesthesia related publications in the coming years

analgesia (n=72) were also prominent topics, reflecting ongoing research interest in perioperative pain management strategies.

The word cloud visualization below illustrates the distribution of the most commonly used keywords in anesthesia-related publications (Figure 4).

The second network map (Figure 5) represents trending research topics over time, with color-coded keywords showing evolutionary patterns in anesthesia research.

Figure 4. Cloud visualization of the most commonly used keywords in anesthesia related publications

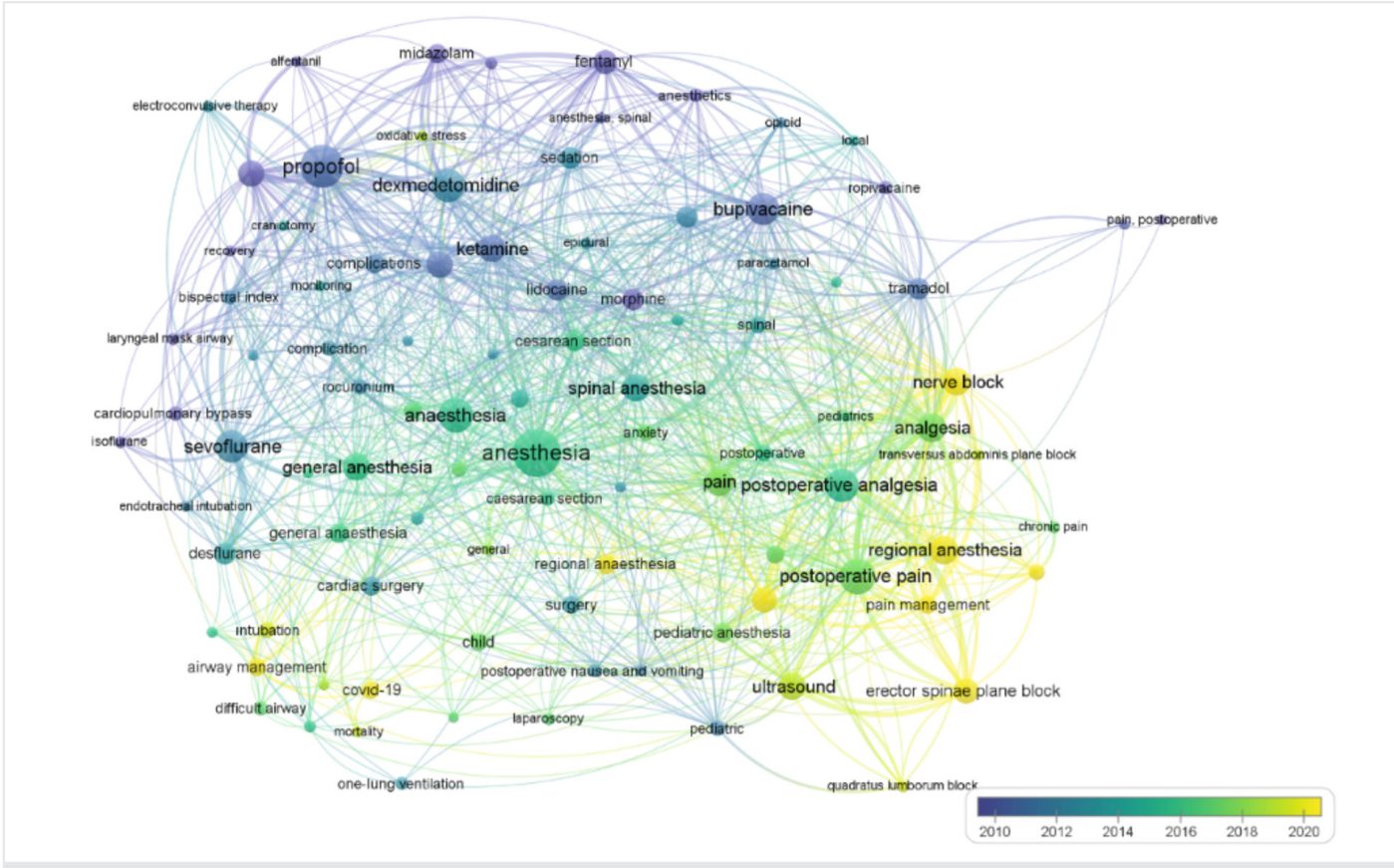

Figure 5. Research topics over time

Discussion

With advancing technology, the sharing and accessibility of information have become increasingly convenient worldwide. The growing exchange of knowledge has enriched the scientific literature. However, as the number of medical publications in scientific databases continues to rise, identifying targeted articles on a specific research topic has become more challenging (9). Several bibliometric analyses have been conducted on different methodologies used in anesthesiology in Türkiye (10-13). This study, however, presents a bibliometric analysis of scientific publications in the field of anesthesiology and reanimation in Türkiye between 1981 and 2024. By systematically reviewing existing research, this study aims to provide insights and guidance for future academic studies in the field.

In this study, the keywords "anesthesia" and "anaesthesia" were analyzed under the "anesthesiology" category. The analysis revealed that the majority of the publications consisted of research articles. It was also observed that Türkiye has contributed to the literature with original and high-quality research.

When evaluating the access types of published articles, a notable increase in "open-access" publications is observed. Open-access publishing allows academics and clinicians to access journal content without requiring a paid subscription. There are several types of open-access models, with the most prominent being "all open access," "gold," "gold-hybrid," "free-to-read," and "green published." It has been noted that authors in Türkiye also utilize these alternatives to share their scientific research through open access.

This trend enhances accessibility to information in anesthesiology research and increases the visibility of scientific studies. As a result, it facilitates the globalization of knowledge, ensuring broader dissemination across the scientific community. Türkiye is also actively contributing to this global movement by aligning with international efforts to share scientific knowledge.

One of the key factors in achieving scientific prominence on a global scale is not only the quantity of scientific publications but also their quality. Countries that embrace this principle have contributed to the increase in the number of articles published in indexed journals within the field of anesthesiology (14). In a 2010 study by Bould et al. (15), which analyzed anesthesiology articles published in SCI journals from 23 countries, Türkiye ranked 7th with 127 publications. In our analysis, rather than making a country-by-country comparison, we aimed to present only Türkiye's data. In this regard, it is evident that the number of publications from Türkiye in these journals has increased over time.

The analysis highlights that researchers seeking higher citation impact should prioritize Q1 and Q2-ranked journals, which not only publish a higher volume of anesthesia-related studies but also yield greater citation influence. Additionally, regional journals continue to play an important role in providing access to country-specific and clinical research findings, further enriching the global anesthesia literature.

In a 2017 study by Yılmaz et al. (16), it was found that the most frequently published articles appeared in the "European Journal of Anaesthesia" and the "Journal of Anesthesia". In this study, the journal with the highest number of publications was the Journal of Clinical Anesthesia (n=339) (Table 5).

It has been observed that the older the faculties or research hospitals, the higher their scientific contribution in terms of publication volume. This can be attributed not only to their longstanding presence but also to their established academic and institutional collaborations, as well as their greater experience and expertise in conducting and publishing scientific research. Additionally, older universities have a well-established academic structure, making it easier for them to secure resources and funding. All these factors contribute to their higher publication output, explaining why older institutions tend to be more prolific in scientific publishing. In our study, İstanbul University, Türkiye's oldest university, ranked first in annual publication output, supporting this observation. Additionally, in relatively younger universities, easier access to extensive resources in the field of anesthesiology has contributed to the rise of their academic productivity. As a result of our bibliometric analysis, projections have been made for future planning. According to these findings, if the same level of productivity continues, Türkiye is expected to maintain a steady increase in anesthesiology research output over the next five years beyond 2024, continually building upon its contributions each year.

In the forthcoming publications, the selection of appropriate keywords will be crucial to ensure that studies can be found quickly, easily, and in a targeted manner within databases. In our study, an analysis of anesthesiology-related keywords revealed that perioperative pain management topics are on the rise. This trend is likely associated with the increasing use of ultrasonography in anesthesiology, which has led to a wider adoption of peripheral nerve blocks and fascial plane blocks in perioperative pain management.

The prevalence of keywords related to perioperative pain management (postoperative pain, postoperative analgesia, regional anesthesia) suggests that contemporary research in anesthesiology is heavily centered on enhancing patient safety, optimizing anesthesia techniques, and improving postoperative recovery (17-19). These findings align with global trends in anesthesiology research, where there is a growing emphasis on opioid-sparing anesthesia techniques, enhanced recovery protocols, and multimodal analgesia approaches (20,21). The dominance of regional anesthesia keyword further suggests an increasing interest in alternatives to general anesthesia, particularly for high-risk patient populations. This keyword analysis provides valuable insights for researchers, journal editors, and funding agencies in identifying emerging trends and research priorities in the field of anesthesiology. When examining the distribution of keywords over the years, it is evident that in the last five years, research topics have increasingly focused on postoperative pain, postoperative analgesia, and regional anesthesia. This trend aligns with the most frequently used keywords, further confirming the growing emphasis on these areas

in contemporary anesthesiology research. The findings suggest a shift towards opioid-sparing anesthesia strategies, regional anesthesia techniques, and multimodal pain management approaches. The increasing research focus on ultrasound-guided procedures and nerve blocks highlights the evolution of safer, more targeted anesthetic practices. These insights offer valuable guidance for future research priorities and funding strategies in anesthesiology.

Study Limitations

Despite these positive trends, certain limitations exist. The bibliometric analysis is inherently influenced by the scope of the WoS Core Collection, which may not capture regional journals and non-indexed publications. Furthermore, while citation analysis provides a measure of research impact, it does not necessarily reflect clinical adoption or translational value.

Another limitation concerns the scope of search terms used during data retrieval. The analysis was restricted to the keywords "anesthesia" and "anaesthesia" within the WoS Core Collection. As a result, related subfields such as "analgesia," "sedation," "pain management," "critical care," or "nerve block" might not have been comprehensively captured. Although this focused strategy ensured consistency and specificity, it may have excluded relevant publications indexed under broader or alternative terminologies. Future studies could adopt a more inclusive set of keywords to provide a more comprehensive overview of anesthesiology-related research.

Future studies should integrate qualitative assessments and clinical impact evaluations to complement bibliometric findings.

Despite these limitations, this study provides a robust bibliometric framework for understanding the evolution of anesthesia research in Türkiye. Addressing these limitations in future studies by incorporating multi-source data, qualitative assessments, and advanced analytical techniques would help further refine our understanding of research dynamics and scientific progress in the field of anesthesiology.

Conclusion

In conclusion, the findings of this study demonstrate an upward trend in Turkish anesthesia research, characterized by increasing publication output, robust institutional participation, and diversification of research topics. The observed trends suggest a continued emphasis on regional anesthesia, multimodal pain control, and patient safety, in alignment with international research directions. Although various scientific studies are conducted in the field of anesthesiology in Türkiye, it has been observed that, as in the rest of the world, regional anesthesia and postoperative pain have gained prominence in recent years. Ultimately, this bibliometric analysis serves as a strategic roadmap for shaping the future of anesthesia research in Türkiye, guiding efforts to enhance scientific output, academic collaborations, and global impact in the field.

Ethics

Ethics Committee Approval: As this study is a bibliometric analysis based on published literature, ethics committee approval was not required. Information has been provided to the ethics committee only through an official letter.

Informed Consent: This is a bibliometric study that systematically analyzes publications in the field of anesthesiology to identify research trends, active institutions and conceptual structures.

Footnotes

Authorship Contributions

Concept: G.A., B.S., Z.S., Design: G.A., K.E., Z.S., Data Collection or Processing: B.S., E.S., Analysis or Interpretation: G.A., B.S., Literature Search: G.A., A.E., Y.Ö., E.S., Writing: G.A., K.E., Z.S.

Conflict of Interest: No conflict of interest was declared by the authors.

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Data Availability Statement: The raw bibliometric data underlying this study, including the Web of Science (WoS) Core Collection query results, query date (December 6, 2024), and applied filters (Category: Anesthesiology; Countries/Regions: Türkiye or Turkey; Document Types: Article, Letter, Review Article, Editorial Material; Indexes: Science Citation Index Expanded (SCIE) or Emerging Sources Citation Index (ESCI), as well as the thesaurus file used for author/affiliation unification, are available from the corresponding author upon reasonable request.

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Original Article

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Traditional, Complementary and Alternative Medicine Studies in Oncology: A Web of Science-based Bibliometric Network Analysis (2020-2024)

Onkolojide Geleneksel, Tamamlayıcı ve Alternatif Tıp Çalışmaları: Web of Science Tabanlı Bibliyometrik Ağ Analizi (2020-2024)

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ABSTRACT

Objective: Traditional and complementary medicine plays a significant role in the prevention and treatment of diseases by supporting modern medical practices. Particularly in the field of oncology, such practices are effective in enhancing patients' quality of life and supporting treatment processes. This study aims to conduct a bibliometric analysis of the scientific literature on traditional, complementary and alternative medicine in oncology between 2020 and 2024.

Methods: A total of 1,884 publications retrieved from the Web of Science Core Collection database were analyzed. The study examined the most cited publications, distribution by year and language, contributing countries, publishers, research areas, and keyword usage. Co-authorship, author citation, country citation, and bibliographic network visualizations were performed using VOSviewer software.

Results: A notable increase in oncology-related studies focusing on traditional and complementary medicine was observed between 2021 and 2024. The United States of America (USA) and China emerged as the leading countries in terms of both publication output and citation impact. Publishers such as Elsevier and Springer

ÖZ

Amaç: Geleneksel ve tamamlayıcı tıp, modern tıp uygulamalarına destek olarak hastalıkların önlenmesi ve tedavisinde önemli bir rol üstlenmektedir. Özellikle onkoloji alanında, bu uygulamalar hastaların yaşam kalitesini artırmada ve tedavi süreçlerini desteklemede etkili yaklaşımlardır. Bu çalışmanın amacı, 2020-2024 yılları arasında onkoloji alanında yapılan geleneksel, tamamlayıcı ve alternatif tıp konusu ile ilgili çalışmaların bibliyometrik analizini yapmaktır.

Yöntemler: Web of Science Core Collection veri tabanından elde edilen 1884 çalışma analiz edilmiştir. En çok atıf alan yayınlar, yıllara ve dillere göre dağılım, katkı sağlayan ülkeler, yayınevleri, araştırma alanları ve anahtar kelime kullanımı gibi değişkenler incelenmiştir. Yazar iş birliği, yazar atıf, ülke atıf ve bibliyografik ağ görselleştirmeleri VOSviewer yazılımı ile yapılmıştır.

Bulgular: 2021-2024 yılları arasında geleneksel ve tamamlayıcı tıp konulu onkoloji çalışmalarında belirgin bir artış olduğu tespit edilmiştir. Yayın sayısı ve atıf bakımından Amerika Birleşik Devletleri (ABD) ve Çin önde gelen ülkeler olarak öne çıkmıştır. Elsevier ve Springer Nature gibi yayınevlerinin bu alandaki araştırmaların yayılmasında önemli rol oynadığı görülmüştür. Mao

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ABSTRACT

Nature played a significant role in disseminating research in this field. Highly cited works included studies by Mao and Zhang. Keyword analysis revealed central themes such as "integrative medicine", "complementary medicine", and "traditional Chinese medicine".

Conclusion: Between 2020 and 2024, there has been growing interest and increased scientific productivity in the field of traditional and complementary medicine in oncology. The USA and China have led this area in terms of publication volume and citations, while publishers like Elsevier and Springer Nature have significantly contributed to its dissemination.

Keywords: Traditional, complementary and alternative medicine (TCAM), oncology, bibliometric analysis

ÖZ

ve Zhang gibi araştırmacıların çalışmaları en yüksek atıf alan yayınlar arasında yer almıştır. Anahtar kelime analizinde "bütünleyici tıp" (*integrative medicine)*, "tamamlayıcı tıp" (*complementary medicine*) ve "geleneksel Çin tıbbı" (*traditional Chinese medicine*) gibi terimlerin literatürde merkezi temalar olduğu belirlenmiştir.

Sonuç: 2020-2024 yılları arasında onkoloji alanında geleneksel ve tamamlayıcı tıp konularına olan ilginin arttığı ve bu alandaki bilimsel üretkenliğin yükseldiği görülmüştür. ABD ve Çin, hem yayın sayısı hem de atıf düzeyleri açısından alanın öncü ülkeleri olarak öne çıkarken, Elsevier ve Springer Nature gibi yayınevleri, alanın gelişimine önemli katkılar sağlamıştır.

Anahtar Kelimeler: Geleneksel, tamamlayıcı ve alternatif tıp (GTAT), onkoloji, bibliyometrik analiz

Introduction

Cancer, a multifaceted and life-threatening disease, continues to pose significant challenges to global public health. Despite advancements in medical science, the complexity of oncological diseases necessitates exploring various therapeutic strategies to address patients' physical, emotional, and psychological needs (1). Global projections suggest that, assuming current incidence trends continue, the overall incidence of cancer will double by 2070 compared with 2020 levels (2). As the prevalence of cancer increases, interest in traditional, complementary and alternative medicine (TCAM; hereafter TCAM) as complementary or independent approaches to conventional oncology is also growing (3). In this context, TCAM is increasingly utilized worldwide as adjunctive therapy in cancer care (4). Traditional medicine encompasses practices rooted in cultural and historical contexts, such as traditional Chinese medicine (TCM; hereafter TCM), Ayurveda, and herbal remedies, which have been tested over time. These systems often emphasize holistic well-being and integrate natural products such as medicinal herbs, acupuncture, and dietary therapies (5). In contrast, alternative medicine refers to non-traditional treatment approaches that are applied instead of conventional therapies (6). Although the lines distinguishing traditional medicine from alternative medicine are often blurred, each typically shares common characteristics for supportive care in oncology, particularly in the management of symptom control, enhancement of quality of life, and the management of side effects resulting from more conventional treatments (7). The use of TCAM among adult cancer patients is increasing and has become widespread; recent research indicates that 87% of individuals with cancer have utilized at least one type of TCAM therapy following their diagnosis (8).

Recent studies across diverse healthcare contexts reinforce the increasing use of TCAM among cancer patients. In Sweden, Wode et al. (9) reported that 34% of patients had used TCAM at some point in their lives, with natural products, vitamins, and TCM being the most common choices. Participants highlighted improvements in physical, emotional, and spiritual well-being as key benefits. A study conducted in Canada by Buckner et al. (10) found that approximately 50% of cancer patients utilized biologically based TCAM, with vitamins and minerals being the most frequently reported modalities. The study further noted that TCAM use tended to increase following diagnosis and was often perceived by patients as a strategy to enhance their sense of control during treatment. Nonetheless, the findings highlighted a lack of sufficient communication between patients and healthcare providers regarding TCAM practices. Among Chinese-speaking patients in Canada, Balneaves et al. (11) observed that decisions to use herbal and energy-based therapies were strongly shaped by cultural values and community support, underlining the sociocultural dimensions of TCAM adoption. In France, a prospective investigation by Gras et al. (12) revealed high engagement with osteopathy, acupuncture, and reflexology, which patients found particularly helpful in mitigating side effects and enhancing satisfaction with care. Similarly, a cross-sectional study in Iran indicated that more than 80% of patients engaged with herbal remedies and supplements, although knowledge levels varied widely, signaling a need for greater patient education (13). In Egypt, Abdelmoaty et al. (14) documented that 64.8% of patients incorporated TCAM into their cancer management-mostly honey and herbal medicine. Notably, 43% did not disclose this usage to their physicians, and over 90% believed that their doctors would disapprove. The study also found that TCAM use was significantly associated with being younger, female, more educated, and having prior experience with TCAM before cancer diagnosis, suggesting identifiable sociodemographic trends.

Several bibliometric studies have previously addressed the intersection of TCAM and oncology. For instance, Yang et al. (15) conducted a foundational network-based bibliometric analysis covering the period between 1989 and 2018, highlighting global collaboration patterns and thematic clusters in TCAM applications for cancer care. Similarly, Moral-Munoz et al. (16) examined the integrative and complementary oncology literature indexed in the Web of Science (WoS) from 1976 to 2017, with

a focus on production trends, international collaborations, and research hotspots such as apoptosis and oxidative stress. While both studies offered valuable historical perspectives, their findings did not reflect the evolving research dynamics and shifting priorities that emerged in the post-2019 era. On the other hand, Maria Helha and Wang (17) provided a bibliometric evaluation of TCAM usage in the context of common mental disorders rather than oncology, drawing on Scopus data from 2001 to 2020. Although thematically relevant, their focus diverges significantly from cancer-specific TCAM applications.

In contrast to these earlier efforts, this study offers a focused and up-to-date bibliometric network analysis of TCAM research in oncology covering the period from 2020 to 2024. By leveraging advanced bibliometric tools such as VOSviewer and Bibliometrix, and restricting the dataset to the WoS Core Collection, this study systematically maps co-authorship networks, institutional collaborations, keyword co-occurrences, and emerging thematic trends within the field. Moreover, it aims to bridge the temporal gap left by earlier analyses by capturing recent post-pandemic research dynamics, evolving global collaborations, and shifting thematic priorities in integrative oncology.

Methods

Since this research was based on secondary data obtained from the WoS database and involves no human subjects, ethical approval was not required. Therefore, patient consent was not necessary.

Study Design and Sample

This study adopts a bibliometric analysis approach to examine academic publications related to TCAM in the field of oncology. The sample consists of scientific articles indexed in the WoS Core Collection within the categories of Science Citation Index (SCI), Social Sciences Citation Index (SSCI), and Emerging Sources Citation Index (ESCI), published between 2020 and 2024.

Inclusion Criteria

1. Articles indexed in the WoS Core Collection (SCI, SSCI, and ESCI categories).

2. Publications dated between January 1, 2020, and December 31, 2024.

3. Articles published in English or other languages, provided that sufficient bibliometric information is available.

4. Original research articles focusing on TCAM in the context of oncology.

Exclusion Criteria

1. Publications dated outside the specified time frame (before January 1, 2020 or after December 31, 2024).

2. Non-research article types such as editorials, letters, conference abstracts, and commentaries.

3. Articles not directly related to TCAM in the context of oncology.

4. Articles lacking sufficient bibliometric data for inclusion in network analysis (e.g., missing author information, citation metadata).

A total of 2032 records were retrieved from the WoS Core Collection. After removing duplicates and applying the inclusion and exclusion criteria, 1884 articles were included in the final bibliometric analysis (Figure 1).

Data Collection Tools

The data were collected from the WoS Core Collection database. The search strategy was defined as: TS=(oncology or cancer) and TS=(traditional medicine or complementary medicine or alternative medicine or "TCAM" or "integrative medicine" or "complementary and integrative medicine"). The following framework guided the data collection process (Table 1).

Statistical Analysis

The statistical analysis in this study was conducted using VOSviewer 1.6.19.0 software. Within the scope of the analysis, several bibliometric parameters were examined, including the most cited studies, the annual distribution of publications, the languages in which they were published, the countries with the highest number of publications and citations, the most prolific publishers and journals, and the most frequently represented subject areas. In addition to these quantitative indicators, visual mapping techniques were employed to gain deeper insights into the structure of the scientific literature. Specifically, co-authorship networks, author citation networks, and author co-citation networks were analyzed. Furthermore, the citation relationships among countries, the co-occurrence of keywords used in the articles, and the bibliographic coupling of texts were also mapped and interpreted to uncover intellectual linkages and collaborative patterns in the field of TCAM in oncology.

Results

This section of the research presents findings on TCAM in oncology, including the number of highly cited publications, distribution by year and language, the country with the highest number of publications and citations, a list of the most prolific publishers and journals, a list of the primary fields with the most publications, co-author network analysis, author citation network analysis, author co-citation network analysis, country citation analysis, keyword co-occurrence analysis, and bibliographic coupling analysis of the texts. The first research question, "What are the most cited studies related to TCAM in the field of oncology?" presents information regarding the top 10 most cited articles in Table 2.

According to the research findings, the study titled "Integrative Oncology: Addressing the Global Challenges of Cancer Prevention and Treatment" by Mao et al. (1) is the most cited work in the field of TCAM in oncology, with 264 citations. This

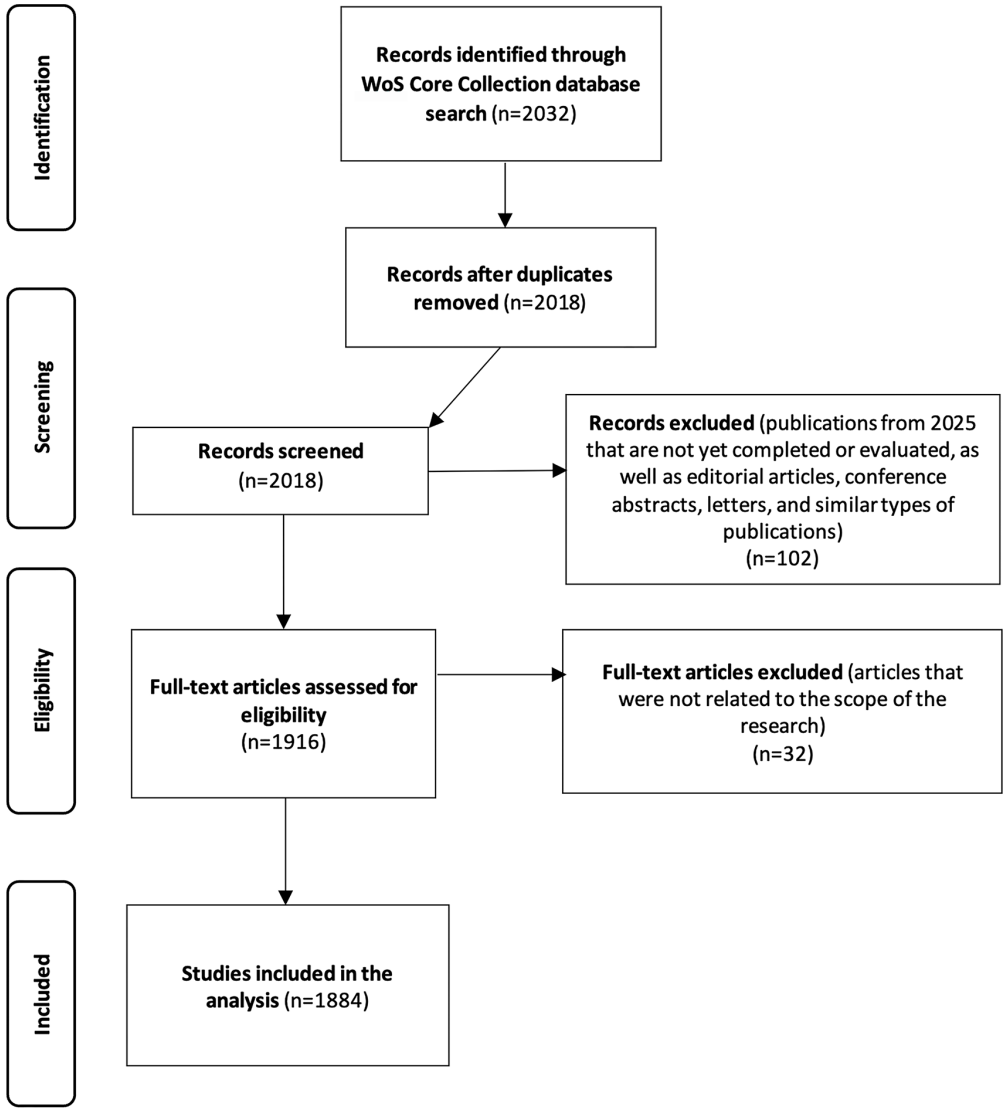

Figure 1. *PRISMA

*A total of 2032 records were retrieved from the WoS Core Collection. After removing duplicates and applying the inclusion and exclusion criteria, 1884 articles were included in the final bibliometric analysis.

PRISMA: Preferred reporting items for systematic reviews and meta-analyses, WoS: Web of Science

study addresses the global challenges of integrative oncology in cancer prevention and treatment, discussing how these approaches can be combined with both traditional and modern medical perspectives. The second most cited work is the research titled "The Positive Role of TCM as an Adjunctive Therapy for Cancer" by Zhang et al. (6), which has received 224 citations. This study emphasizes the positive effects of TCM as an adjunctive therapy in cancer treatment and examines the importance of integrating these therapies with biomedical applications. The third-ranked study is the article titled "Cellular Senescence and Cancer: Focusing on TCM and Natural Products" by Liu et al. (18), which has received 185 citations. This study investigates the relationship between cellular senescence and cancer, focusing on the potential roles of TCM and natural products in this process. The findings illuminate the field's development from both clinical and theoretical perspectives, underscoring its significance in the academic community literature.

Upon examining Figure 2, it is notable that there has been a significant increase in publications related to TCAM in the field of oncology over the years. Particularly after 2020, there was a marked rise in the number of publications, with continued interest evident in 2021 and subsequent years. This trend indicates that the topic is gaining increasing importance in the academic realm and that researchers' interest in this area is rising. According to Figure 3, it is observed that a vast majority of studies related to TCAM in the field of oncology are written in English

Table 1. Search frame

Parameters	Selection
Selection approach	Bibliometric analysis
Database used	WoS Core Collection
Tools used for analysis	VOSviewer
Search query	TS=(oncology or cancer) and TS=(traditional medicine or complementary medicine or alternative medicine or "traditional, complementary and alternative medicine" or "integrative medicine" or "complementary and integrative medicine")
Nature of the document	Article
Time period	2020-2024
Subject area	All areas
Total number of documents for analysis	1884
Publication stage	Published

WoS: Web of Science, VOSviewer: Visualization of similarities viewer, TS: Topic

Table 2. Information on the top 10 most cited articles

Article name	Authors	Year	Journal	Number of citations
Integrative oncology: addressing the global challenges of cancer prevention and treatment	Mao et al. (1)	2022	CA Cancer J Clin	264
The positive role of traditional Chinese medicine as an adjunctive therapy for cancer	Zhang et al. (6)	2021	Biosci Trends	224
Cellular senescence and cancer: focusing on traditional Chinese medicine and natural products	Liu et al. (18)	2020	Cell Prolif	185
Traditional Chinese medicine and lung cancer-from theory to practice	Li et al. (19)	2021	Biomed Pharmacother	168
The signaling pathways and targets of traditional Chinese medicine and natural medicine in triple-negative breast cancer	Yang et al. (20)	2021	J Ethnopharmacol	152
Integrative medicine for pain management in oncology: society for integrative oncology-American Society of Clinical Oncology guideline	Mao et al. (21)	2022	J Clin Oncol	150
Metabolic reprogramming by traditional Chinese medicine and its role in effective cancer therapy	Wang et al. (22)	2021	Pharmacol Res	135
Benzimidazole and its derivatives as cancer therapeutics: the potential role from traditional to precision medicine	Lee et al. (23)	2023	Acta Pharm Sin B	124
Clinical application and mechanism of traditional Chinese medicine in treatment of lung cancer	Su et al. (24)	2020	Chin Med J (Engl)	103
Traditional Chinese medicine as supportive care for the management of liver cancer: past, present, and future	Liao et al. (7)	2020	Genes Dis	95

(1838 publications). The number of publications in other languages is limited; German ranks second with 32 publications. According to Figure 4, Ben-Arye E is the most prolific author in studies related to TCAM in oncology, with 50 publications. This highlights Ben-Arye E's significant contributions to the field and the wide recognition of their work within academic circles. Following Ben-Arye E and Samuels N with 42 publications and Cramer H with 28 publications. Other notable authors include Witt CM with 25 publications, and Gressel O, Lopez G, Ng JY, and Mao JJ each with 22 publications. This trend indicates that research on TCAM in oncology necessitates a multidisciplinary approach and is examined from various perspectives by different researchers. The work of leading authors like Ben-Arye E and Samuels N has established foundational methodologies in the field and serves as important reference points in the academic literature. According to Figure 5, the United States of America (USA) is the clear leader in publication output, with 570 studies on TCAM in oncology, reflecting the country's pioneering role in global health research and its comprehensive academic infrastructure. Following the USA, China ranks second with 448 publications, a position that can be linked to the historical roots of TCM and the increasing integration of these approaches into modern oncology. However, as shown in Figure 6, China leads in citation impact with 3,478 citations, indicating that its research is highly influential and widely referenced in the international academic community. The USA ranks second in citation count, with 2,829 citations, underscoring that while the USA demonstrates high research productivity, China's

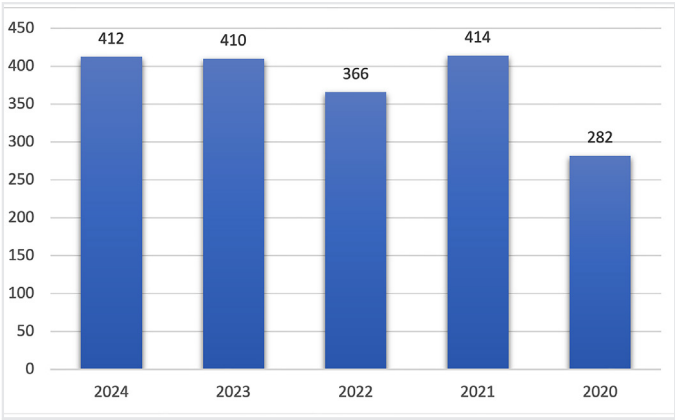

Figure 2. Distribution of studies by year

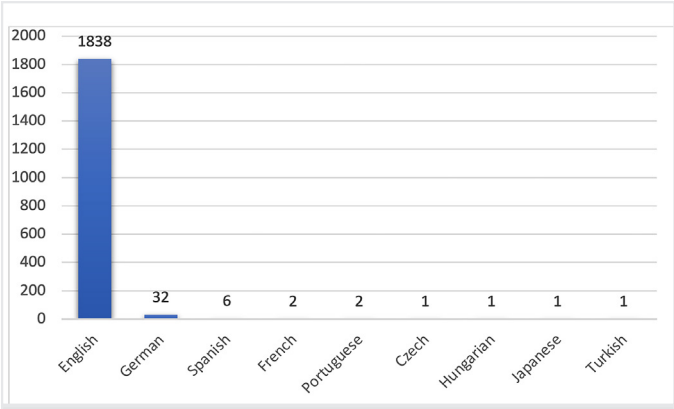

Figure 3. Distribution of studies by language

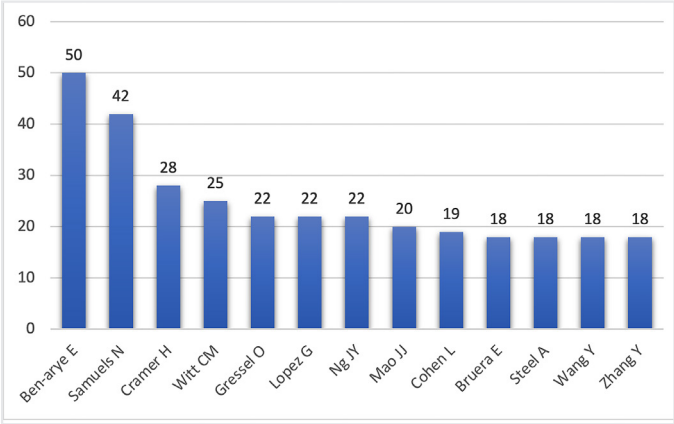

Figure 4. Distribution of studies by authors

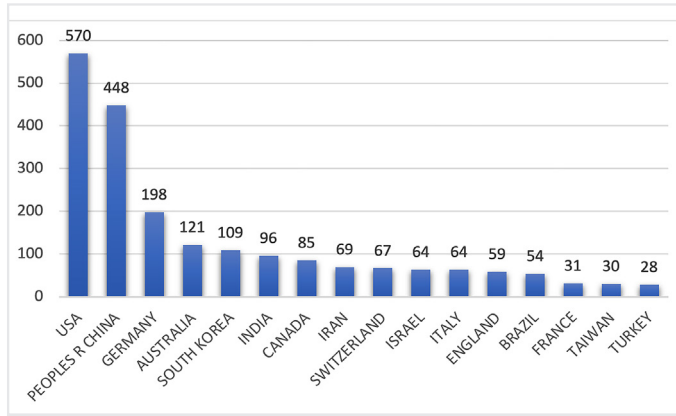

Figure 5. Distribution of studies by country

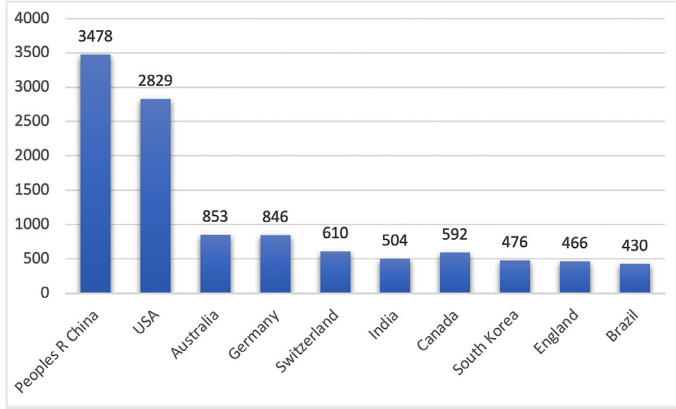

Figure 6. Distribution of studies according to most cited countries

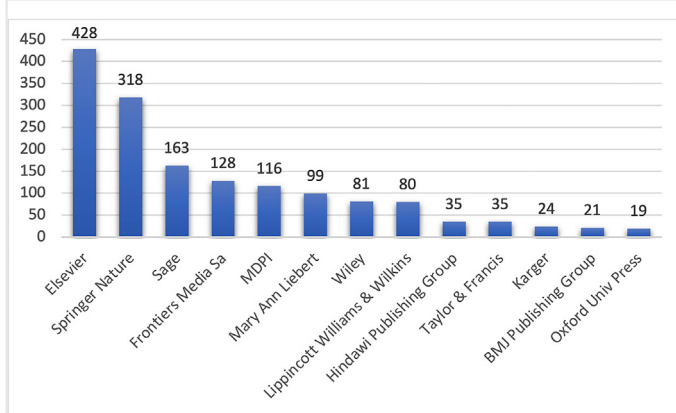

Figure 7. Distribution of studies by publishers

MDPI: Multidisciplinary Digital Publishing Institute

contributions have achieved greater visibility and impact in the global literature. According to Figure 7, in the distribution of studies on TCAM in the field of oncology by publishers, Elsevier stands out as the leading publisher with 428 publications. Elsevier's leading position is indicative of its extensive academic publishing network and strong presence in the field of health sciences. Following Elsevier, Springer Nature ranks second with 318 publications, reflecting Springer's strong position as a key player in multidisciplinary scientific publishing. Other prominent publishers include Sage (163 publications), Frontiers Media SA (128 publications), and Multidisciplinary Digital Publishing Institute (MDPI) Multidisciplinary Digital Publishing Institute (116 publications). These publishers contribute to the broader dissemination of research, mainly through their open-access and multidisciplinary approaches. According to Figure 8, in the distribution of studies on TCAM in the field of oncology by journals, Integr Cancer Ther stands out as the leading journal with 93 publications. This indicates that the journal

is a prominent platform for scientific publications related to complementary and integrative medicine in oncology. BMC Complement Med Ther ranks second with 62 publications and is noted for its open-access policies and broad multidisciplinary approach. Other significant journals include Front Pharmacol (50 publications), the J Integr Med (45 publications), and the Eur J Integr Med (43 publications). These journals contribute to the development of the field by serving as bridges between traditional medicine and modern pharmacology and integrative approaches. According to Figure 9, the primary field with the highest number of publications on TCAM in the field of oncology is Integrative Medicine (671 publications). This finding suggests that integrative medicine is a central focal point for combining traditional and modern approaches. The fields of oncology (312 publications) and medicine general (208 publications) rank second and third, respectively, suggesting that these areas are directly related to studies focused on oncology. Fields such as pharmacology (207 publications) and health care sciences (130 publications) emphasize the pharmacological dimensions of complementary medicine practices and their impact on health services. Although these fields have lower publication counts, areas like rehabilitation (78 publications), public environmental health (69 publications), and clinical neurology (56 publications) reflect the importance of interdisciplinary

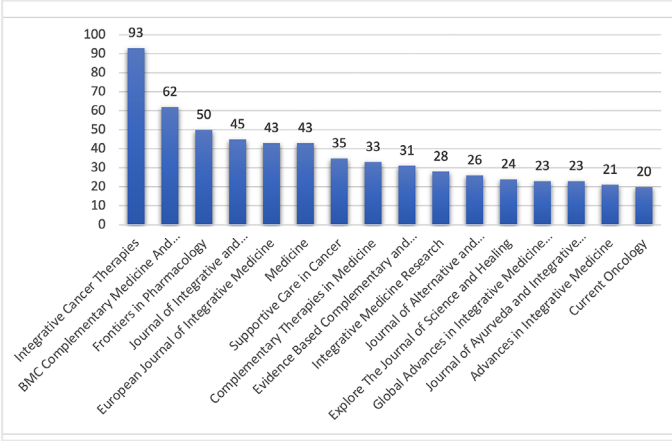

Figure 8. Distribution of studies by journals

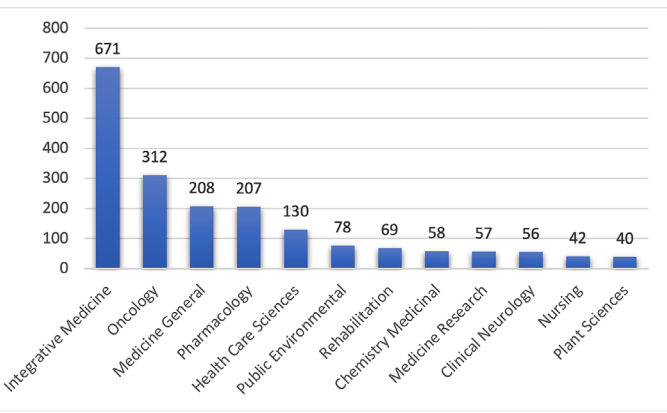

Figure 9. Main areas with most publications

approaches in this context. Nursing (42 publications) and plant sciences (40 publications) are among the other fields that provide more specific yet practical contributions to this area. These data indicate that studies on TCAM in the field of oncology not only attract interest in clinical practices but also engage various scientific disciplines through a multidisciplinary approach.

According to the co-author network analysis depicted in Figure 10, the analysis reveals a significant collaboration network among researchers working on TCAM in oncology, structured into five colour-coded clusters that represent cohesive thematic communities. The figure, which includes 29 authors, reveals dense collaboration among the authors. The visual proximity and clustering of authors suggest active intra- and inter-cluster collaboration patterns, especially around key nodes. Within the network, authors such as Ben-Arye E, Samuels N and Cramer H occupy central positions, making significant contributions to the literature in the field. Notably, Ben-Arye E stands out as one of the most influential figures in the network, with a connection strength of 97, playing an active role in both individual and collective scientific production. Cramer H appears to function as a connector between otherwise separate groups, supporting interdisciplinary knowledge exchange. Similarly, authors such as Samuels N and Lopez G possess high connection strength, reinforcing their visibility and integrative role across research clusters. According to the author citation network analysis presented in Figure 11, there are 24 authors and four distinct clusters. Among these authors, 127 connections were identified, highlighting their strong citation relationships. Within the network, Ben-Arye E occupies a central position with a total connection strength of 404 and has a strong citation network with many other authors. This indicates that Ben-Arye E is frequently referenced in studies related to TCAM in oncology. In Figure 12, the author co-citation network related to TCAM in oncology is visualized, showing the connections among authors who are cited together in different articles. According to the network analysis, there are 25 authors and three distinct clusters. Among these authors, 271 connections were identified, demonstrating the interconnected structure of the literature in the field. Authors such as Mao JJ, Ben-Arye E and Witt CM occupy central positions within the network. Notably, Mao JJ stands out as one of the most influential authors, with a total connection strength of 804. This indicates that Mao's work is frequently referenced in the literature and has a broad impact. Other authors, such as Ben-Arye E and Witt CM also form significant nodes in the network with high connection strength, emerging as reference points in the interdisciplinary literature. The network graph in Figure 12 is divided into clusters of different colors. Each color represents a specific theme or research focus. For instance, Mao JJ and Ben-Arye E are concentrated in the red cluster, while authors such as the WHO and Ernst E are situated in the green cluster. In the blue cluster, Asian-origin researchers like Zhang Y and Wang Y stand out. Figure 13 illustrates the inter-country citation network analysis within the context of TCAM studies in oncology. The analysis includes a total of 24 countries and five different clusters, with 175 connections between the countries. This finding highlights

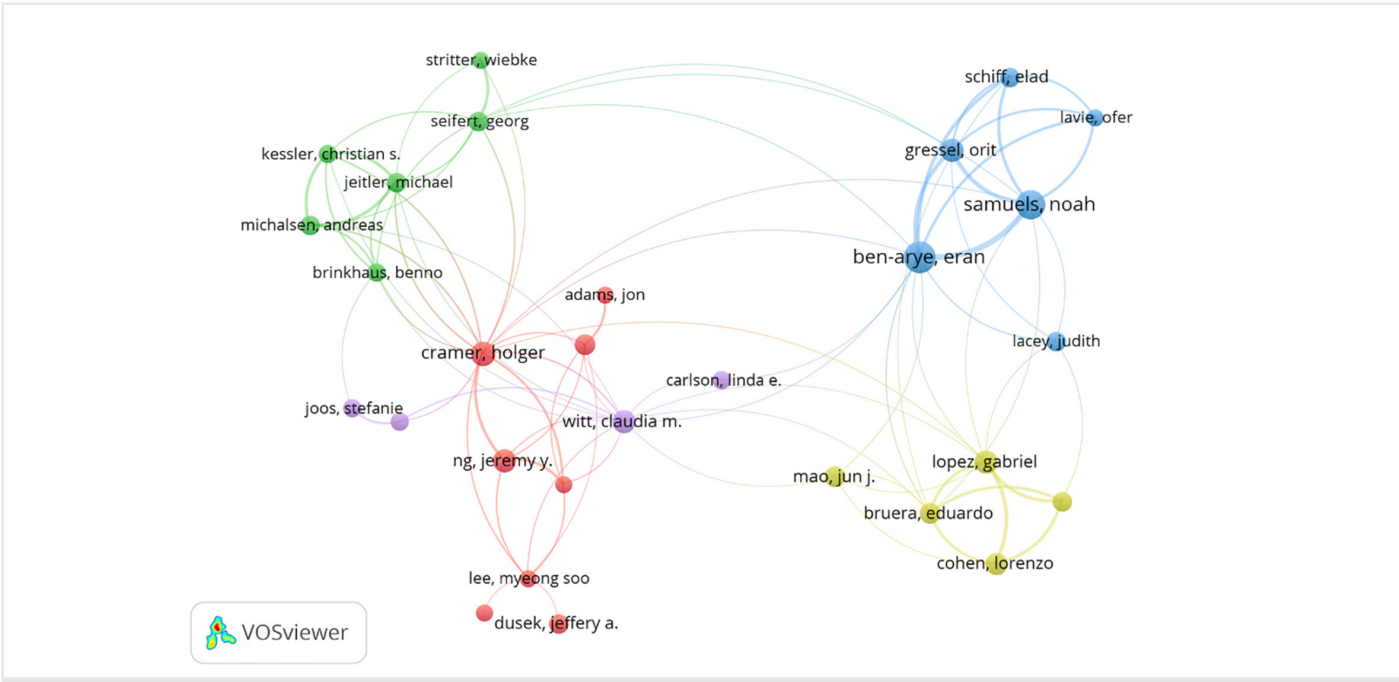

Figure 10. Co-author network analysis

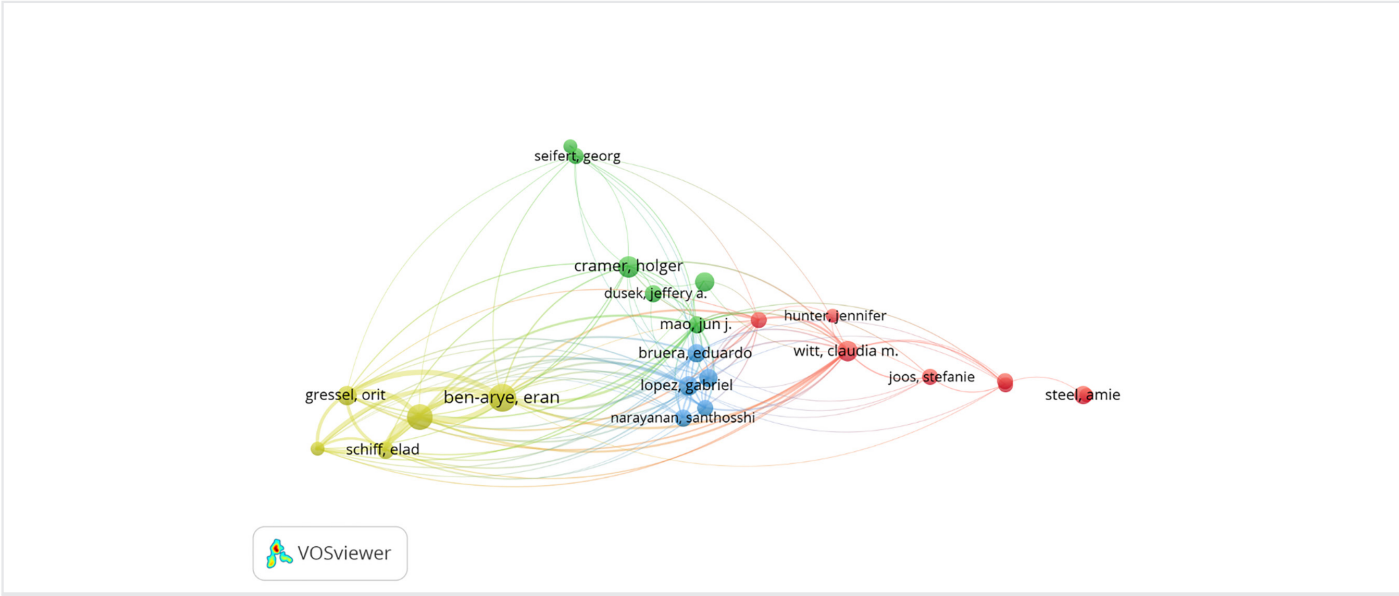

Figure 11. Author citation network analysis

the strong academic interactions and collaborations among the countries. The USA, located at the center of the network, holds the most influential position with a total connection strength of 649. The USA has particularly intense citation connections with China, the United Kingdom, Germany, South Korea, and Australia. This indicates that the USA is leading in international literature and frequently referenced by other countries. China, with a total connection strength of 209, is another central country in the network. China has a strong citation relationship with the USA, indicating that both countries are pioneering in the literature. Additionally, China's connections with Asian and Western countries further enhance its global influence in this area. This influence is particularly rooted in China's leadership in TCM, which represents a significant thematic pillar within TCAM research in oncology. The increasing global recognition of TCM-based therapies-such as acupuncture, herbal medicine, and energy-based practices grounded in the concept of Qi (the traditional notion of vital life energy)-has further elevated China's prominence in scholarly discourse. The strong citation linkage between China and the USA reflects a broader convergence of Eastern and Western medical paradigms, especially in fields related to symptom management, palliative

care, and the integration of evidence-based complementary therapies into cancer treatment. Figure 14 presents the keyword co-occurrence analysis of articles related to TCAM in oncology. According to the analysis, there are a total of 48 keywords and five different clusters. In total, 561 connections were identified, demonstrating how frequently the keywords are used and how central they are in the literature. The most prominent keyword is "Integrative Medicine", which appears 381 times, making it the network's largest and most central node. This term indicates that the studies are primarily focused on integrative medicine. Other keywords, such as "Complementary Medicine" (138 times) and "TCM" (195 times), also represent focal points of the research. Additionally, terms like "Cancer" (151 times), "Acupuncture" (120 times), and "Quality of Life" (70 times) signify important topics in the field.

The clusters represented by colors illustrate the relationships between specific themes. For example, the red cluster, which includes terms such as "TCM", "Chemotherapy", and "Apoptosis", focuses on traditional medicine and cancer biology. In contrast, the blue cluster, which contains terms like "Integrative Oncology", "Pain", and "Palliative Care", represents studies related to integrative oncology and the quality of life for patients. These clusters not only reveal thematic orientations but also demonstrate how TCAM research in oncology is diversifying. The blue cluster also groups mind-body approaches

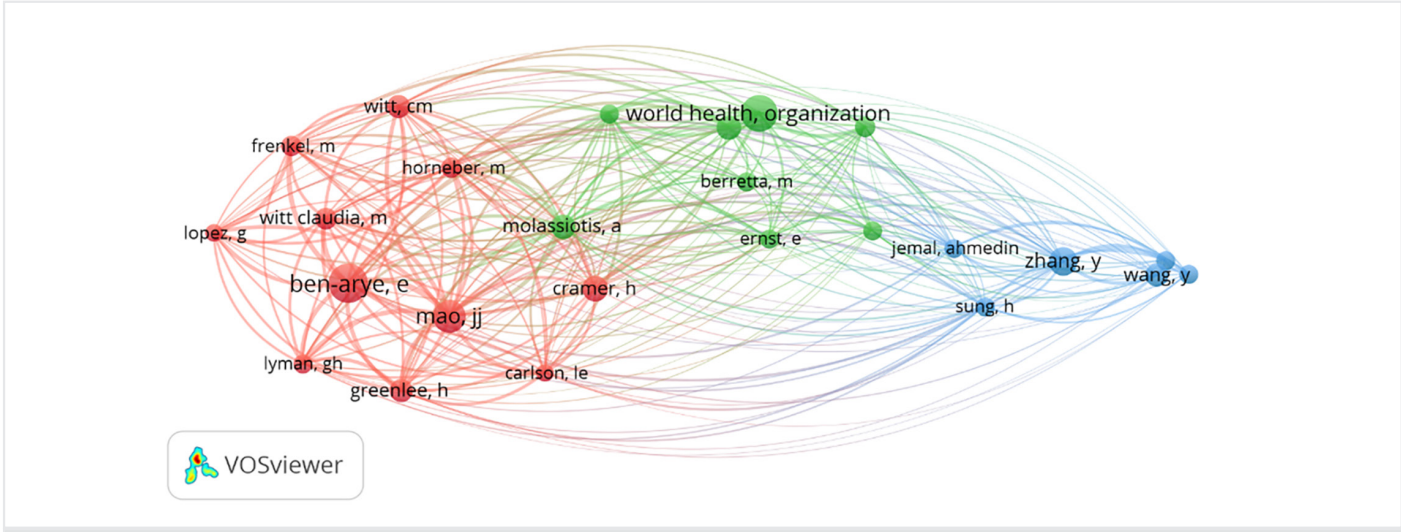

Figure 12. Author co-citation network analysis

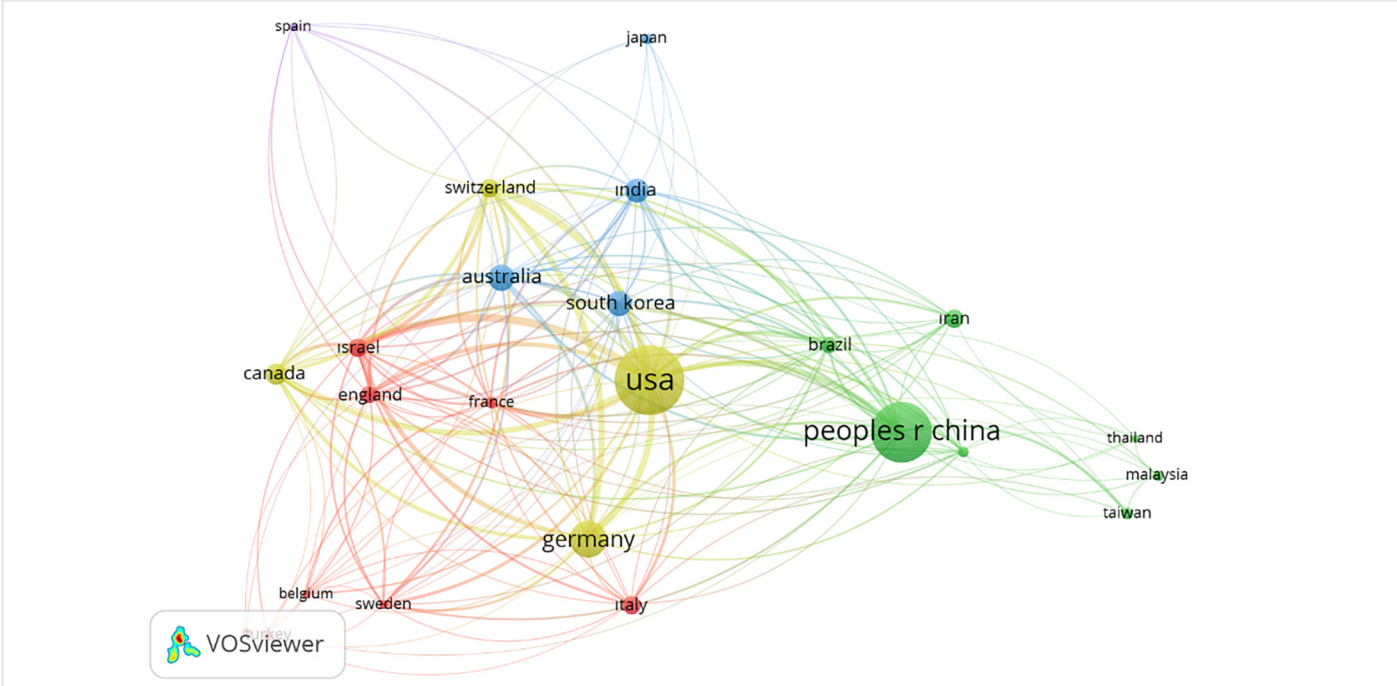

Figure 13. Country citation network analysis

such as "yoga", "meditation", and "pain", indicating a focus on symptom relief and emotional well-being. In contrast, the red cluster centers around "TCM", "chemotherapy", and "apoptosis", suggesting a strong connection between herbal or traditional interventions and biological mechanisms of cancer treatment. The green cluster encompasses terms like "qualitative research", "complementary therapies", and "education", reflecting interest in patient experience, healthcare delivery, and the integration of TCAM into clinical contexts. Figure 15 presents the bibliographic coupling analysis of texts related to TCAM in oncology. This analysis visualizes the key reference points in the literature and the impact of research in the field. The bibliographic analysis identifies 14 authors and three different clusters, with 91 connections among the authors. Ben-Arye E and Samuels N emerge as the most decisive nodes at the center of the network. Ben-Arye E, with a connection strength of 11,414, demonstrates

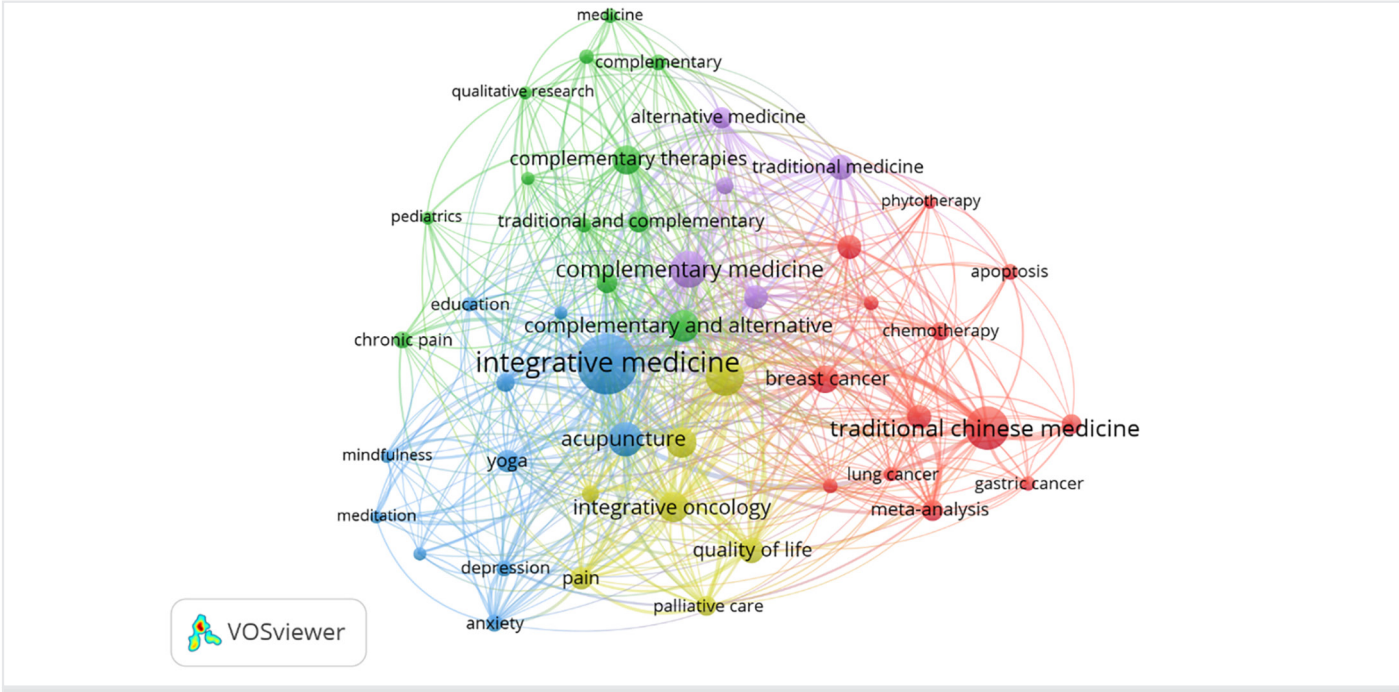

Figure 14. Keyword co-occurrence analysis

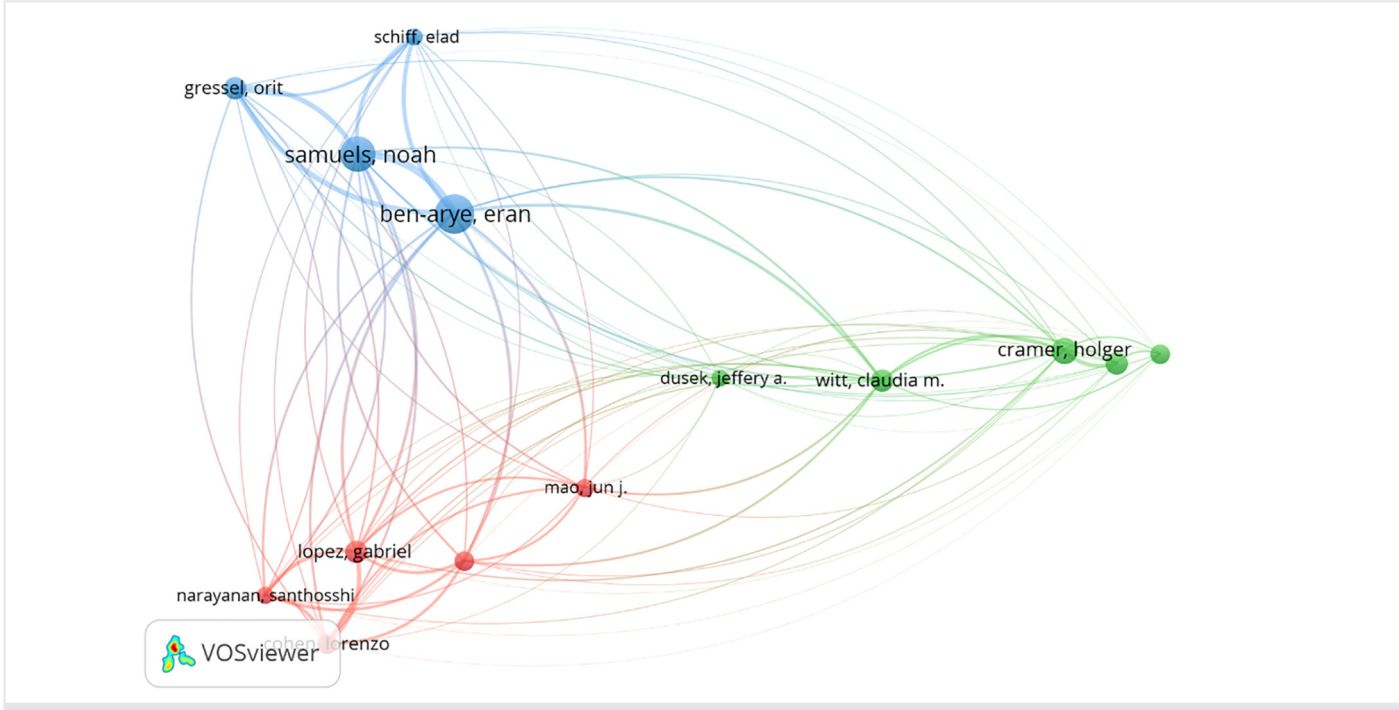

Figure 15. Bibliographic coupling analysis

his central position in the literature, indicating that his works are frequently referenced in the field's literature and serve as a guiding source for other research. Samuels N and Cramer H are also important nodes, standing out as key actors in the literature. Another notable node in the network is Mao JJ, who has an interdisciplinary impact and significantly contributes to the flow of information in research studies. Additionally, despite being smaller nodes, authors like Lopez G and Witt CM enhance interactions in the field's literature by establishing important connections. This analysis provides an important framework for understanding which authors have established the foundational pillars of the literature in TCAM studies in oncology and how they guide the flow of information. Names such as Ben-Arye E, Samuels N, and Mao JJ are key reference points in the field and shape the literature.

Discussion

The findings of this bibliometric network analysis suggest the rising global interest in TCAM within oncology. Over the 2020-2024 period, there has been a marked increase in academic publications focusing on integrative approaches, reflecting a broader transformation in how cancer care is conceptualized - not merely as a clinical intervention but as a holistic process that addresses the physical, emotional, and psychosocial needs of patients. The leading roles of countries such as the USA and China demonstrate both scientific investment and cultural heritage in this area. While the USA contributes through structured academic research and interdisciplinary collaboration, China brings the historical depth of TCM into contemporary scientific frameworks. This mutual exchange has strengthened international scholarly collaboration and enriched the thematic diversity observed in this study. The keyword and thematic cluster analyses reveal a focused interest in terms like “integrative medicine”, “TCM”, “complementary therapies”, and “quality of life”, suggesting that the field has begun to coalesce around shared priorities and research goals. This suggests a transition from isolated studies to more structured, cumulative knowledge production that supports the integration of TCAM into evidence-based oncology practices. Co-authorship and citation network analyses also identify authors such as Ben-Arye E, Mao JJ, and Samuels N as central figures, indicating their influence in shaping the scholarly landscape of integrative oncology.

When compared with earlier bibliometric investigations, the results of this analysis both reaffirm and expand upon prior findings. Yang et al. (15) covering publications from 1989 to 2018, identified dominant themes related to herbal treatments and symptom management. The current analysis shows that while these topics remain relevant, there has been a notable thematic shift toward psychosocial interventions, including mindfulness and yoga, indicating a transition toward more patient-centered research. Similarly, Moral-Munoz et al. (16) emphasized apoptosis and oxidative stress as core topics in literature indexed before 2017. In contrast, the present keyword network identifies “quality of life” and “palliative care” as more central, reflecting updated research priorities aligned with supportive care. Maria Helha and Wang (17), focusing on TCAM in mental health contexts, noted increased publication rates in recent years. A comparable trend is observed in the oncology-specific literature, suggesting that the growing interest in CAM spans multiple medical disciplines and is driven by broader shifts toward holistic health paradigms. From a methodological perspective, the country-level citation network highlights intensified scholarly exchange between the USA and China, a pattern not as pronounced in earlier studies. Moreover, the emergence of multidisciplinary clusters-including terms associated with qualitative research, patient communication, and implementation-points to a diversification of research agendas in TCAM-oncology. These developments may significantly influence guideline formulation and service delivery models in the near future.

Recent high-impact studies substantiate the clinical relevance of TCAM in oncology. Mao et al. (1) reported that integrative oncology protocols attenuate treatment-related toxicity and improve long-term survivorship outcomes. Zhang et al. (6) observed enhanced chemotherapy tolerance and better symptom control when TCM is delivered as an adjuvant modality. Liu et al. (18) highlighted anti-senescence pathways activated by specific herbal compounds, thereby identifying molecular targets for future drug development. Taken together, these findings suggest that TCAM interventions contribute not only to supportive care but also to disease-modifying strategies in contemporary cancer management. From a managerial perspective, the expanding evidence base supports the inclusion of integrative oncology services in cancer centers, the re-allocation of resources toward multidisciplinary teams, and the development of reimbursement models that cover validated TCAM interventions. Such alignment is expected to improve patient satisfaction, streamline care pathways, and potentially reduce overall treatment costs.

Study Limitations

This study is limited to data retrieved exclusively from the WoS Core Collection database. Although databases such as Scopus, PubMed, or Google Scholar offer broader or more specialized coverage, the WoS was selected to ensure data consistency, avoid duplicate records, and maintain compatibility with bibliometric analysis tools. The WoS is widely preferred in bibliometric studies due to its structured metadata and established citation indexing standards.

Additionally, the analyzed studies cover only the period between 2020 and 2024. This specific time frame was deliberately chosen because a previous comprehensive bibliometric study by Yang et al. (15) had already examined the literature on TCAM in oncology from 1989 to 2018. By beginning with the year 2020, the present study aims to provide an updated continuation of that earlier work and to better reflect recent shifts and trends in the literature.

Conclusion

This study presents a comprehensive bibliometric analysis covering 1884 studies on TCAM in oncology between 2020 and 2024. The findings demonstrate a significant increase in research

activity in this area, particularly between 2021 and 2024, with a focus on integrative approaches. The majority of the studies were published in English, and countries such as the USA, China, and Germany emerged as the leading contributors to the literature. Publishers including Elsevier, Springer Nature, and MDPI played a key role in disseminating research in this field. Co-authorship and citation network analyses highlight the central position of authors such as Ben-Arye E, Mao JJ, and Samuels N who have actively shaped interdisciplinary research in integrative oncology. Keywords such as "Integrative Medicine", "Complementary Medicine", and "TCM" represent the main research themes, while the prominent role of the USA and China in the global literature underscores the importance of international academic collaboration. Overall, these findings highlight the growing recognition of the need to integrate modern medicine and traditional approaches in oncology research.

This study has several limitations. The analysis was restricted to publications indexed in the WoS Core Collection and to the 2020-2024 period, which may have excluded relevant studies from other databases or earlier years. The reliance on bibliometric indicators also emphasizes citation quantity over content quality or clinical impact, and the predominance of English-language publications may underrepresent important regional or non-English contributions. Future research should aim to expand the data sources to include databases such as Scopus, PubMed, and regional indexes, enabling a more comprehensive mapping of global scholarly activity. Additionally, integrating bibliometric data with clinical and economic outcomes-such as treatment efficacy, patient satisfaction, and cost-effectiveness-would help bridge the gap between academic influence and real-world applicability. In summary, the integration of TCAM with contemporary oncological approaches is likely to gain increasing importance in the coming years and has the potential to contribute significantly to evidence-based, patient-centred cancer care.

Ethics

Ethics Committee Approval: Since this research was based on secondary data obtained from the WoS database and involves no human subjects, ethical approval was not required.

Informed Consent: Therefore, patient consent was not necessary.

Footnotes

Authorship Contributions

Concept: B.A., F.A., B.T., A.İ., Design: B.A., B.T., A.İ., Data Collection or Processing: F.A., M.B.D., Analysis or Interpretation: F.A., B.T., M.B.D., A.İ., Literature Search: B.A., M.B.D., Writing: B.A., F.A., B.T., M.B.D., A.İ.

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Original Article

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The Impact of Obesity Hypoventilation Syndrome on Exercise Capacity, Peripheral Muscle Strength, and Quality of Life in Obese Individuals - A Cross-sectional Comparison Study

Obez Bireylerde Obezite Hipoventilasyon Sendromunun Egzersiz Kapasitesi, Periferik Kas Kuvveti ve Yaşam Kalitesine Etkisi - Kesitsel Karşılaştırma Çalışması

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ABSTRACT

Objective: Obesity hypoventilation syndrome (OHS) is characterized by respiratory dysfunction in addition to obesity and may adversely affect exercise capacity, peripheral muscle strength and quality of life. The aim of this study was to investigate the effects of OHS on exercise capacity, peripheral muscle strength and quality of life in obese individuals.

Methods: A total of 64 participants, 32 with OHS and 32 with simple obesity, were included in the study. Demographic and clinical data were collected. Clinical data included polysomnography results and comorbid conditions (Charlson comorbidity index). Exercise capacity was assessed using the six-minute walk test, and peripheral muscle strength was assessed using a digital hand dynamometer and a hydraulic hand dynamometer. Quality of life was assessed using the Nottingham health profile (NHP) and sleep quality using the Pittsburgh sleep quality index (PSQI). Body composition and circumference measurements were recorded.

ÖZ

Amaç: Obezite hipoventilasyon sendromu (OHS), obeziteye ek olarak solunum fonksiyon bozukluğu ile karakterizedir ve egzersiz kapasitesini, periferik kas gücünü ve yaşam kalitesini olumsuz yönde etkileyebilir. Bu çalışmanın amacı, obez bireylerde OHS'nin egzersiz kapasitesi, periferik kas gücü ve yaşam kalitesi üzerindeki etkilerini araştırmaktır.

Yöntemler: Çalışmaya 32'si OHS'li ve 32'si basit obez olmak üzere toplam 64 katılımcı dahil edilmiştir. Demografik ve klinik veriler kaydedilmiştir. Klinik verileri içerisine polisomnografi sonuçları ile komorbid durumları (Charlson komorbidite indeksi) kaydedilmiştir. Egzersiz kapasitesi altı dakika yürüme testi ile değerlendirilmiş, periferik kas gücü dijital el dinamometresi ve hidrolik el dinamometresi kullanılarak ölçülmüştür. Yaşam kalitesi Nottingham sağlık profili (NHP) ile uyku kalitesi ise Pittsburgh Uyku kalitesi indeksi (PSQI) ile değerlendirilmiştir. Vücut kompozisyonu ve çevresel ölçümler kaydedilmiştir.

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ABSTRACT

Results: The obese group had significantly better six-minute walk distance [500.44±40.46; p=0.021; 95% confidence interval (CI)=0.59] and right/left quadriceps strength (186.66±35.14; p=0.004; 95% CI=0.75)/(184.56±34.56; p=0.005; 95% CI=0.74). The OHS group had significantly higher NHP total score (243.13±105.54; p<0.001; 95% CI=1.75) and subscores [energy level (58.90±35.51; p=0.001; 95% CI=0.87), emotional status (31.81±29.73; p=0.029; 95% CI=0.56), sleep (43.60±26.01; p<0.001; 95% CI=1.96), PSQI total (8.66±3.98; p=0.001; 95% CI=2.14) and neck circumference (42.62±3.77; p=0.025; 95% CI=0.57). No statistically significant differences were observed in the other outcome measures (p>0.005).

Conclusion: These findings suggest that people with OHS have lower exercise capacity and muscle strength, and poorer quality of life and sleep than those with simple obesity. This highlights the need for targeted interventions to improve physical function and overall well-being in patients with OHS.

Keywords: Obesity hypoventilation syndrome, obesity, exercise capacity, peripheral muscle strength, quality of life

ÖZ

Bulgular: Basit obez grubunun altı dakika yürüme mesafesi [500,44±40,46; p=0,021; %95 güven aralığı (GA)=0,59] ve sağ ve sol kuadriseps kas güçleri (186,66±35,14; p=0,004; %95 CI=0,75) (184,56±34,56; p=0,005; %95 GA=0,74) anlamlı olarak daha yüksekti. OHS grubunun NHP toplam (243,13±105,54; p<0,001; %95 GA=1,75) ve alt skorları [enerji düzeyi (58,90±35,51; p=0,001; %95 GA=0,87), duygusal durum (31,81±29,73; p=0,029; %95 GA=0,56), uyku (43,60±26,01; p<0,001; %95 GA=1,96), PSQI toplam skoru (8,66±3,98; p=0,001; %95 GA=2,14) ve boyun çevresi (42,62±3,77; p=0,025; %95 GA=0,57) anlamlı derecede yüksek bulundu. Diğer sonuç ölçütlerinde istatistiksel olarak anlamlı bir fark elde edilmedi (p>0,005).

Sonuç: Bu bulgular, OHS'li bireylerin basit obez bireylere kıyasla daha düşük egzersiz kapasitesine ve kas gücüne sahip olduğunu, ayrıca yaşam ve uyku kalitelerinin daha kötü olduğunu göstermektedir. Bu durum, OHS hastalarında fiziksel fonksiyon ve genel iyilik halini iyileştirmeye yönelik hedefe yönelik müdahalelerin gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Obezite hipoventilasyon sendromu, obezite, egzersiz kapasitesi, periferik kas gücü, yaşam kalitesi

Introduction

Obesity hypoventilation syndrome (OHS) is a condition seen in individuals with a body mass index (BMI) over 30 kg/m², characterized by elevated carbon dioxide levels during the day [partial carbon dioxide pressure ($PaCO_2$) >45 mmHg] and breathing disturbances during sleep, without any other identifiable cause of hypoventilation (e.g., chest wall disorders, neuromuscular disease or metabolic conditions) (1,2). Although the prevalence of OHS is not known exactly, it is thought that the prevalence of obesity and OHS are directly proportional (3,4).

The characteristic symptoms of OHS are described as a sensation of choking during sleep due to apnea, loud snoring, morning headaches, and excessive daytime sleepiness (5). In addition to these symptoms, research has also demonstrated that respiratory mechanics, respiratory muscle strength, pulmonary gas exchange, and lung functions are adversely affected (6).

The impact of obesity on the cardiovascular system, respiratory mechanics, respiratory muscle strength, respiratory control, gas exchange, breathing patterns, lung volumes, and work of breathing is serious. The evidence suggests that the accumulation of excess fat and a sedentary lifestyle in obese individuals result in a decrease in exercise capacity due to increased energy expenditure. Studies have indicated that people with obesity generally have reduced physical activity levels, diminished peripheral muscle strength, an increased risk of sleep-related breathing disorders, and a compromised health-related quality of life. The alterations observed in obesity account for the influence of various factors involved in the pathogenesis of OHS (7,8).

Hypercapnia ($PaCO_2$>45 mmHg) is a condition characterized by an increase in arterial carbon dioxide pressure ($PaCO_2$). The elevation in $PaCO_2$ occurs due to the cessation of ventilation during apneic events and the ongoing metabolic production of CO_2. In contrast, individuals with eucapnia are able to normalize their $PaCO_2$ levels by increasing alveolar ventilation. However, in patients with OHS, this compensatory mechanism is impaired, resulting in elevated CO_2 levels in the blood. In summary, the persistence of elevated carbon dioxide levels reflects a state of chronic hypercapnia. Elevated carbon dioxide levels are a key factor in the pathophysiology of OHS and act as a defining characteristic among sleep-related breathing disorders. The rise in $PaCO_2$ pressure in these patients results in symptoms such as daytime fatigue, excessive sleepiness, headaches and emotional changes, thereby indirectly contributing to a decline in quality of life (9).

Multiple studies have demonstrated that the excessive buildup of adipose tissue in individuals with obesity negatively affects peripheral muscle strength, exercise capacity, and quality of life (6,10). A comprehensive evaluation of exercise capacity, peripheral muscle strength, and quality of life in individuals with OHS is of particular importance for understanding the disease prognosis and management strategies. In view of the complex and heterogeneous nature of OHS, the specific effects of the syndrome on functional and clinical parameters remain insufficiently elucidated. In the absence of such evaluations, the development of targeted therapeutic interventions is significantly impeded. Incorporating these parameters into clinical assessment may also help clarify unexplained patient-reported symptoms and contribute to a more personalized and effective treatment approach. A deeper understanding of the effects of hypercapnia, which plays a key role in the pathogenesis of OHS, would facilitate a more detailed evaluation of its impacts and support the development of appropriate treatment programs based on

assessment outcomes. Developing effective treatment strategies targeting hypercapnia and its related consequences may help improve health-related quality of life. The aim of this study was to investigate the effects of OHS on peripheral muscle strength, exercise capacity and quality of life in obese individuals.

Methods

The research was conducted in compliance with the Declaration of Helsinki, and informed voluntary consent was secured from all participants. Ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of İstanbul University-Cerrahpaşa (number: E-74555795-050.04-899354, date: 26.01.2024), and the study was registered in the ClinicalTrials database under the registration number NCT06142513.

The study included a total of 64 participants. Thirty two individuals diagnosed with OHS by a pulmonologist and monitored at the Department of Pulmonary Diseases constituted the study group. OHS was diagnosed by a pulmonologist using polysomnography analysis. Arterial blood gas analysis was performed in polysomnography analysis to evaluate hypercapnia. An apnea-hypopnea index (AHI) of ≥5 per hour indicates sleep apnea (11). Thirty two obese individuals followed up at the Obesity Clinic of the Division of Endocrinology and Metabolism, İstanbul University, İstanbul Faculty of Medicine who were classified as having low risk according to the STOP-Bang assessment constituted the control group. Individuals with concomitant chronic respiratory disease, orthopedic or neurological conditions that could prevent exercise testing, or unstable cardiac disease were excluded from the study.

The BMI, gender, age, smoking habits, regular medication and presence of comorbidities of the individuals included in the study were questioned. None of the patients were using bronchodilators. In addition, AHI and mean saturation values according to polysomnography analysis and pH, CO_2 and saturation values according to arterial blood gas analysis performed in the morning were recorded in patients with OHS. The assessment process involved a multifaceted evaluation of various parameters, including functional peripheral muscle strength, exercise capacity, sleep quality, anthropometric measurements and quality of life. It is noteworthy that all assessments were conducted by a single physiotherapist, ensuring consistency and reliability in the data collection process. The entire evaluation process lasted approximately 45 minutes.

Functional Exercise Capacity

The six-minute walk test (6MWT) was utilized to evaluate the exercise capacity of the participants, with the test being conducted in accordance with the criteria established by the American Thoracic Society. Participants were instructed to walk at their own pace along a 30 m straight corridor, with standardised verbal instructions and encouragement phrases being employed at predetermined intervals. It was communicated to the participants that they were permitted to rest under specific conditions during the test, however, the test itself would proceed. Blood pressure, heart rate, and oxygen saturation were recorded before and after the test, and dyspnea and leg fatigue were assessed using the modified Borg scale. The total distance walked at the end of the test was recorded in m (12,13).

Muscle Strength

Quadriceps muscle strength was evaluated using a digital handheld dynamometer (K-Push Kinvent Hand Held Dynamometer, Montpellier, France). In a study using the K-Push Handheld Dynamometer to assess muscle strength in individuals, the device demonstrated intrarater reliability with results of ≥0.84 for torque, ≥0.80 for force, and ≥0.64 for normalised torque (14). Measurements were conducted three times for both the right and left quadriceps muscles, and the mean value of the three trials was recorded in Newtons (15,16).

Handgrip strength was assessed utilizing a hydraulic hand dynamometer (Jamar Hydraulic Hand Dynamometer, Pennsylvania, USA). In a study evaluating the test-retest, intra- and inter-rater reliability of the Jamar device in healthy individuals, the intra-rater intraclass correlation coefficients (ICC) of the Jamar, which is commonly used, were reported to be between 0.996 and 0.998, and the inter-rater ICCs were reported to be between 0.94 and 0.98 (17). These findings support the robustness of Jamar-based grip strength measurements in our study. The measurement was performed three times on the dominant hand, and the average of the three trials was documented in Newtons (18,19).

The Quality of Life

The participants' quality of life was evaluated using the Nottingham health profile (NHP), a general questionnaire designed to assess individuals' health issues and the impact of these issues on daily activities. The questionnaire includes 38 statements, divided into six categories: pain (eight statements), energy level (three statements), sleep (five statements), social isolation (five statements), emotional reactions (nine statements), and physical mobility (eight statements). The answers follow a yes/no structure, and each subscale is measured on a 0-100 scale, with increased scores representing a more severe health condition. The validity and reliability of the Turkish version of the questionnaire were established by Kucukkdeveci et al. (20).

Anthropometric Measurements

Participants' body fluid percentage (%), body fat percentage (%) and muscle mass (kg) parameters were assessed with the Tanita BC-545N body composition analyzer (14). Support for its reliability comes from a recent validation study in healthy adults, which reported excellent test-retest ICC values (≥0.999) for whole-body metrics and 0.973-1.000 for regional components, along with strong agreement versus dual-energy X-ray absorptiometry (21). In our study, circumference measurements were performed while the patient was standing upright with equal weight on both feet. Neck, waist, abdominal, and hip circumferences were measured using a measuring tape and recorded in cm.

Comorbidity

The comorbidity status of the subjects was evaluated using the Charlson comorbidity index (CCI). The CCI encompasses 19 distinct comorbid conditions, each assigned a score ranging from 1 to 6, with a maximum total score of 37. In the calculation of the total score, a point is allocated for each decade of life beginning at the age of 40. A higher score signifies the presence of multiple comorbidities (22,23).

Sleep Quality

The study employed the Pittsburgh sleep quality index (PSQI) to gauge participants' sleep quality. The PSQI is a 19-question self-assessment tool designed to analyze sleep patterns and disturbances over the last month. It comprises seven components: sleep latency, habitual sleep efficiency, daytime dysfunction, subjective sleep quality, use of sleep medication, sleep duration and sleep disturbances. Items are scored 0-3, with cumulative scores spanning 0-21, a total exceeding 5 signifies impaired sleep quality (24,25). The scale's reliability and validity for Turkish populations were confirmed by Agargun et al. (26).

Sample Size Calculation

The required sample size was calculated a priori using G*Power 3.1. Based on an estimated medium effect size (f=0.3), 80% power, and α=0.05, the analysis indicated that a minimum of 64 participants would be required to detect significant effects (27). Considering a potential dropout rate of approximately 10%, a total of 70 participants were initially enrolled. During the study, six participants withdrew due to personal reasons; thus, the study was completed with 64 participants.

Statistical Analysis

The data obtained at the conclusion of the study were analysed using SPSS Statistics version 24 (IBM Statistical Package for the Social Sciences, New York, USA). Descriptive statistics were calculated for all variables and presented as mean (standard deviation) or frequency (percentage). The normality of the distribution was assessed using the Shapiro-Wilk test. Variables between groups were analysed using the independent samples t-test. Multivariate analysis of variance (MANOVA) was performed to evaluate the effects of group differences on multiple dependent variables simultaneously. A p-value of <0.05 was considered to be statistically significant.

Results

Seventy patients were enrolled to participate in the study. As the evaluation of three patients could not be completed and three patients did not wish to participate in the study, a total of 64 patients were included in the study. The demographic and clinical characteristics of the patients included in the study are shown in Tables 1 and 2. There were no differences between the groups in terms of age, gender, smoking and comorbidity scores (p>0.05). The results and comparisons of exercise capacity, peripheral muscle strength, quality of life and sleep quality are shown in Table 3. 6MWD was significantly higher in the obese group (p=0.021).

Table 1. Demographic and clinical characteristics of the groups

	Obesity group (n=32)	OHS group (n=32)	Cohen's d (95% CI)	p-value
Age (years) mean ± SD	45.06±11.46	49.69±8.55	0.46 (-0.04 ; 0.95)	0.072
Gender n (%)				
Female	19 (59.4)	17 (53.1)	N/A	0.614
Male	13 (40.6)	15 (46.9)		
Smoking status n (%)				
Current smoker	6 (18.8)	6 (18.8)	N/A	
Non-smoker	26 (81.3)	26 (81.3)		
Charlson comorbidity index score	1.46±0.76	1.68±0.64	0.31 (-0.18 ; 0.80)	0.219

SD: Standard deviation, n: Number, N/A: Not available, CI: Confidence interval

Table 2. Polysomnography parameters of the OHS group

	OHS group (n=32) Mean ± SD	Normative value
Polysomnography parameters		
AHI	54.25±36.03	<5
Average saturation in sleep	89.84±4.27	95-100%
$PaCO_2$	49.33±3.16	<45 mmHg
SaO_2	94.20±4.55	96-100%

OHS: Obesity hypoventilation syndrome, NIVM: Non-invasive mechanical ventilation, AHI: Apnea-hypopnea index, $PaCO_2$: Partial carbon dioxide pressure, SaO_2: Oxygen saturation, SD: Standard deviation, n: Number

Right and left quadriceps muscles strengths were significantly higher in the obesity group (p=0.004 and p=0.005 respectively). There was no significant difference in hand grip strength between the groups (p=0.092). The NHP total score, NHP subscores for energy level, emotional status and sleep score were significantly higher in the OHS group (p=0.000, p=0.001, p=0.029 and p=0.000, respectively). There was no difference between groups for the NHP subscores of pain, physical activity and social isolation (p>0.05). The PSQI total score was statistically higher in the OHS group (p=0.000). The results of the MANOVA test are presented in Tables 4 and 5. The MANOVA analysis revealed that at least one of the dependent variables differed significantly between the independent variable groups tested (λ=0.382; p<0.001). Examination of the findings in the table indicated that, according to the one-way MANOVA results, there were statistically significant differences between the study groups (obesity and OHS) in terms of 6MWD (f=5.636; p=0.021), quadriceps muscle strength (right, f=9.017; p=0.004 and left, f=8.662; p=0.005), NHP scores (f=49.122; p<0.001), and PSQI scores (f=73.077; p<0.001). When examining the highest η^2 values, the presence of OHS explained 54.1% of the variance in PSQI scores (η^2=0.541) and 44.2% of the variance in NHP scores (η^2=0.442). At the 95% confidence level (1-α), the observed power (1-β) was 100% for the variable with the largest effect size (PSQI, d=2.14), and 64.7% for the variable with the smallest effect size (6MWD, d=0.593). The results and comparisons of body composition and anthropometric measurements are shown in Table 6. Body composition, abdominal, hip and waist circumferences were similar in both groups (p>0.05). Neck circumference was significantly higher in the OHS group than in the obese group (p=0.025).

Table 3. Comparison of exercise capacity, muscle strength, quality of life and sleep quality between groups

	Obesity group (n=32) Mean ± SD	OHS group (n=32) Mean ± SD	Cohen's d (95% CI)	p-value
6MWD (m)	500.44±40.46	474.09±47.99	0.59 (0.09;1.09)	**0.021**
QS - Right (N)	186.66±35.14	159.73±36.57	0.75 (0.24;1.26)	**0.004**
QS - Left (N)	184.56±34.56	158.38±36.57	0.74 (0.23;1.24)	**0.005**
Grip strength (N)	288.10±104.90	244.80±97.40	0.42 (-0.08;0.91)	0.101
NHP - Total score	95.98±54.42	243.13±105.54	1.75 (1.17;2.33)	**<0.001**
NHP - Pain	30.11±32.00	33.49±26.27	0.12 (-0.38;0.61)	0.645
NHP - Physical activity	22.53±13.04	27.42±19.47	0.30 (-0.20;0.79)	0.243
NHP - Energy level	29.60±31.90	58.90±35.51	0.87 (0.36;1.38)	**0.001**
NHP - Social isolation	20.39±30.18	14.45±20.71	0.23 (-0.26;0.72)	0.363
NHP - Emotional status	16.88±23.37	31.81±29.73	0.56 (0.06;1.06)	**0.029**
NHP - Sleep	6.06±4.44	43.60±26.01	1.96 (1.36;2.56)	**<0.001**
PSQI - Total score	2.28±1.37	8.66±3.98	2.14 (1.51;2.75)	**<0.001**

6MWD: Six minute walking distance, QS: Quadriceps strength, N: Newton, NHP: Nottingham health profile, PSQI: Pittsburgh sleep quality index, SD: Standard deviation, n: Number, CI: Confidence interval

Table 4. Multivariate analysis of variance (MANOVA) results showing the overall group effect on exercise capacity, muscle strength, quality of life, and sleep quality

Effect	Wilks lambda (λ)	F	p-value
Group	**0.382**	5.636	**0.001**

Table 5. Univariate ANOVA results for group effect on exercise capacity, muscle strength, quality of life, and sleep quality

Dependent variable	F	p-value	Partial η^2	Observed power (1-β)
6MWD (m)	5.636	0.021	0.083	0.647
QS - Right (N)	9.017	0.004	0.127	0.840
QS - Left (N)	8.662	0.005	0.123	0.826
Grip Strength (N)	2.766	0.101	0.043	0.374
NHP - Total score	49.122	<0.001	0.442	1
PSQI- Total score	73.077	<0.001	0.541	1

ANOVA: Analysis of variance, 6MWD: Six minute walking distance, QS: Quadriceps strength, N: Newton, NHP: Nottingham health profile, PSQI: Pittsburgh sleep quality index, n: Number, CI: Confidence interval

Table 6. Comparison of body composition and anthropometric measurements between groups

	Obesity group (n=32) Mean ± SD	OHS group (n=32) Mean ± SD	Cohen's d (95% CI)	p-value
BMI (kg/m²)	35.05±3.02	36.17±3.10	0.37 (-0.13;0.86)	0.149
Body fat (%)	39.29±5.82	40.08±7.18	0.12 (-0.37;0.61)	0.631
Total body water (%)	43.18±7.57	41.79±7.43	0.19 (-0.31;0.68)	0.462
Muscle mass (kg)	54.42±11.90	54.29±11.28	0.01 (-0.48;0.50)	0.964
Neck circumference (cm)	40.75±2.66	42.62±3.77	0.57 (0.07;1.07)	**0.025**
Waist circumference (cm)	110.72±8.71	111.94±7.16	0.15 (-0.34;0.64)	0.543
Abdominal circumference (cm)	118.41±9.16	121.12±8.71	0.30 (-0.19;0.80)	0.229
Hip circumference (cm)	119.78±9.95	122.22±10.37	0.24 (-0.25;0.73)	0.341
Waist-hip ratio	0.92±0.070	0.92±0.075	0.09 (-0.40;0.58)	0.720

BMI: Body mass index, SD: Standard deviation, n: Number, CI: Confidence interval

Discussion

This study examined the impact of OHS on peripheral muscle strength, exercise tolerance, and quality of life in obese individuals, comparing these parameters between OHS patients and those with simple obesity.

The assessment of patients suffering from sleep-related breathing disorders is of crucial importance in order to understand the progression of the disease and to interpret health-related quality of life. Cardiopulmonary exercise testing (CPET) and the 6MWT are the most common tests used to evaluate exercise capacity. The 6MWT is recognized for its simplicity, reproducibility, and ease of administration, offering a reliable reflection of daily life activities (28). In obese individuals, the 6MWD has been shown to be shorter compared to normal-weight individuals due to higher energy expenditure and metabolic demands during walking (29). In the presence of sleep-related breathing disorders, reduced functional residual capacity and increased respiratory workload lead to elevated energy expenditure in patients. Tidal volume is reduced, breathing becomes superficial, and respiratory rate increases. As both the respiratory effort and energy consumption increase, fatigue may occur, which can have a negative impact on exercise capacity. Furthermore, chronic hypoventilation has been shown to impair respiratory muscle endurance, while apneic episodes during sleep exacerbate intermittent hypoxemia, further reducing oxygen delivery to the muscles and deteriorating functional performance (30,31). In the present study, we demonstrated that exercise capacity was further reduced in individuals with OHS compared to those with simple obesity. The greater impairment in exercise capacity in OHS patients compared to those with simple obesity may be associated with other clinical features related to sleep disorders. Therefore, although sleep-disordered breathing is undoubtedly a factor, it is believed that these mechanisms associated with hypercapnia play an important role and require further investigation in future studies.

It has been suggested that individuals with obesity tend to exhibit reduced antigravity muscle strength compared to those with normal weight (32). Increased adipose tissue may contribute to diminished sympathetic neural activation and alterations in muscle fiber structure (33). In individuals diagnosed with obstructive sleep apnea syndrome (OSAS), previous studies have reported lower quadriceps muscle strength and poorer functional performance compared to healthy controls (34). Although the distribution of muscle fiber types appeared similar in a study comparing individuals with severe OSAS and healthy subjects, differences in fiber diameter and protein content were observed. In the context of sleep-disordered breathing, the repetitive cycles of deoxygenation and reoxygenation caused by apneas and hypopneas are thought to contribute to intermittent hypoxemia (35). Sauleda et al. (36) have reported that chronic hypoxemia may influence skeletal muscle structure and enzyme activation. In our study, we observed that peripheral muscle strength was lower in individuals with OHS compared to those with obesity. We believe that chronic hypoxemia and hypercapnia in individuals with OHS might contribute to disturbances in skeletal muscle pH homeostasis, which could in turn affect enzymatic activity and reduce blood flow to muscle tissue, potentially impacting muscle strength. We suggest that future studies focus on exploring the underlying mechanisms of peripheral muscle weakness in patients with OHS, potentially through muscle biopsies and pH-related biochemical assessments.

Handgrip strength is a widely accepted metric for evaluating overall muscular function in the upper limbs. A recent study examined the relationship between handgrip strength, insulin resistance, C-reactive protein levels, and body composition in obese and normal-weight individuals across various age groups. The findings revealed a negative correlation between prolonged excess adipose tissue and handgrip strength, suggesting that prolonged exposure to excess adipose tissue might contribute to a decline in muscular strength (37). In a further study, the relationship between apnea severity, sleep duration, and handgrip strength in individuals diagnosed with OSAS was examined. No significant difference in handgrip strength was observed among individuals with varying apnea severity (38). Lee (39), emphasised a robust correlation between sleep duration of five hours or less and diminished handgrip strength, along with an augmented risk of sleep-related breathing disorders. In this study, there was no

statistically significant difference between obese group and OHS group in terms of grip strength. When the normative data of healthy individuals were compared according to gender in both groups, it was observed that only women in the OHS group had decreased hand grip strength compared to healthy individuals (40). Obese group had higher grip strength. We think that this may be explained by the advantageous effects of increased body mass, especially associated with obesity, on hand muscles. Hand grip strength may be preserved in obese men with OHS and obese women, but it is important to evaluate these individuals in terms of muscular endurance and functional capacity.

Obesity has an effect on many factors such as physical functions, social behaviors and emotional status. Studies reported that the quality of life of individuals diagnosed with OHS was worse compared to OSAS patients (41,42). In our study, similar to other studies, it was observed that the general quality of life score of individuals diagnosed with OHS was worse than that of obese individuals. In addition, the NHP emotional status sub-score was also more affected than obese group. Anxiety and depression scores were higher in individuals with OHS compared with healthy controls (43). In our study, no scale was used to assess anxiety and depression. However, this difference in the NHP emotional state subscore suggests that chronic hypoxaemia and hypercapnia, which are characteristic features of OHS, may affect emotional functioning. Unlike obesity, OHS has a wider impact on an individual's quality of life. The more pronounced clinical symptoms of OHS may increase the perception of chronic illness in individuals. This may explain the poorer overall quality of life and emotional status of people with OHS. We believe that this is due to impaired sleep quality, reduced physical activity levels and variable emotional state due to the presence of hypercapnia associated with chronic hypoxaemia with excess adipose tissue. There was no difference between individuals with OHS and obese individuals in the quality of life sub-scores of pain, physical activity and social isolation. Both groups may be affected by physical difficulties from obesity, sedentary lifestyles, and similar barriers to social participation.

OHS is a sleep-related breathing disorder characterised by the presence of hypercapnia, alongside obesity, and its impact on the quality of sleep in individuals with the condition has been extensively researched. In a study evaluating sleep quality and respiratory muscle strength in individuals diagnosed with simple obesity and OHS, it was shown that hypercapnia accompanying chronic hypoventilation decreased sleep quality, caused excessive daytime sleepiness and increased the severity of fatigue (44). Another study compared sleep parameters, daytime sleepiness, and quality of life among obese OSAS patients, normal-weight OSAS patients, and individuals with OHS. The results indicated that individuals with OHS exhibited higher levels of daytime sleepiness and poorer sleep quality in comparison to the two other groups (41). Consistent with the findings of these studies and in line with the prevailing theories, our study also demonstrated that the presence of hypercapnia in individuals with OHS resulted in diminished sleep quality when compared to obese individuals. This phenomenon is attributed to the disruption of the respiratory cycle during sleep, a consequence of the combination of obesity and chronic hypoventilation.

To evaluate multivariate effects across outcome measures, a MANOVA analysis was performed. The results were consistent with our pairwise comparisons and confirmed significant group effects. According to the MANOVA results, the strongest effect sizes were observed in the NHP and PSQI scores, both demonstrating a statistical power of 100% (1-β=1). In contrast, the weakest effect was found in the 6MWD, with a statistical power of 64.7% (1-β=0.647). These findings highlight the varying impact of OHS on different functional domains and strengthen the clinical relevance of evaluating exercise capacity, peripheral muscle strength, quality of life, and sleep in this population.

Study Limitations

There are some limitations to this study. The exercise capacity of the participants was assessed using the 6MWT. However, employing the gold standard measurement method, CPET instead of the 6MWT, could enhance the objectivity of the results obtained. Polysomnography analysis was performed exclusively on subjects diagnosed with OHS according to the inclusion criteria of the study. In the control group, which consisted of individuals with simple obesity, polysomnography and arterial blood gas analysis were not conducted. Consequently, a comparison of polysomnography findings between the two groups was rendered unfeasible. Although participants with high STOP-Bang scores were excluded from the study, objective diagnostic assessments were not performed. This represents a potential limitation in interpreting the comparisons between groups. The study did not collect data on potential confounding variables such as patients' physical activity levels, glycemic control in diabetic patients, and nutritional status. We consider it necessary to include these parameters in future studies to increase the validity and interpretability of the results. In our study, assessments were performed by a single physiotherapist who was not blinded. Furthermore, our study had a cross-sectional design, which limited causal inference. These factors may affect the internal validity of the study and should be taken into account when interpreting the findings.

Conclusion

The results demonstrate significantly poorer outcomes in OHS patients compared to those with simple obesity, including reduced peripheral muscle strength, diminished exercise capacity, impaired quality of life and worse sleep quality scores. Persistent hypercapnia in obesity induces intracellular acidosis in skeletal muscle, impairing both contractile function and mitochondrial enzyme activity. This pathophysiology leads to measurable declines in peripheral muscle strength, exercise tolerance, and ultimately health-related quality of life. In future studies, comparing the effectiveness of exercise training in individuals with OHS and simple obesity may contribute to the development of more targeted individualised rehabilitation programmes.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of İstanbul University-Cerrahpaşa (number: E-74555795-050.04-899354, date: 26.01.2024)

Informed Consent: Informed voluntary consent was secured from all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: E.A., Ö.E.H., G.K.A., Concept: E.A., Ö.E.H., G.K.A., E.K., Design: E.A., Ö.E.H., G.K.A., B.A., Data Collection or Processing: E.A., Ö.E.H., G.K.A., B.A., B.F.Ç., E.K., Analysis or Interpretation: E.A., Ö.E.H., G.K.A., Literature Search: E.A., Ö.E.H., G.K.A., Writing: E.A., Ö.E.H., G.K.A., B.A., B.F.Ç., E.K.

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Original Article

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Sustainability of Health Services in a University Hospital During Disaster: The Kahramanmaraş Earthquakes Experience

Bir Üniversite Hastanesinde Afet Döneminde Sağlık Hizmetlerinin Sürdürülebilirliği: Kahramanmaraş Depremleri Deneyimi

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ABSTRACT

Objective: The diverse impacts and repercussions of catastrophes underscore the need for hospitals to enhance their physical and functional resilience, as well as to strengthen their preparedness for interventions. Disasters lead to an increased demand for health services. The earthquakes that occurred in Türkiye on February 6, 2023, concentrated in Kahramanmaraş and impacted 11 regions, exemplifying an unusual situation when power and resources were inadequate. This research investigates the experiences of Kahramanmaraş Sütçü İmam University Faculty of Medicine Hospital, situated near the disaster's epicenter, to ascertain objectives for maintaining continuous and efficient healthcare service delivery during catastrophes.

Methods: This study utilizes a phenomenological research design, which is a qualitative research methodology. Data were gathered via semi-structured interviews with 19 individuals. The interviews were examined using the MAXQDA analytic software, with results classified into two primary themes: crisis management and individual experience.

ÖZ

Amaç: Dünyadaki afetlerin çok yönlü etki ve sonuçları, hastanelerin afetlere fiziksel ve işlevsel olarak daha dayanıklı ve müdahalelere daha hazırlıklı olmaları gerekliliğine dikkat çekmektedir. Hem doğal hem de insan kaynaklı çok sayıda farklı afet ve acil durumun yaşandığı Türkiye'de, özellikle deprem ve pandemiler olmak üzere afet ve acil durumların neden olduğu kitlesel yaralanmalar ve hastalıkların artması, sağlık sistemine, özellikle de hastanelere yoğun bir ek iş yükü getirmektedir. Türkiye'de 06 Şubat 2023'te Kahramanmaraş'ta merkezlenen ve 11 ili etkileyen deprem, güç ve kaynakların yetersiz kaldığı nadir afetlerden biridir. Bu çalışmada, depremin merkez üssünde bulunan Kahramanmaraş Sütçü İmam Üniversitesi Tıp Fakültesi Hastanesi'nin deprem deneyimleri incelenerek, afetlerde sağlık hizmetlerinin kesintisiz ve etkin bir şekilde yürütülmesi için önceliklerin belirlenmesi amaçlanmıştır.

Yöntemler: Çalışmanın yöntemi, nitel araştırma desenlerinden biri olan fenomenolojik desendir. Çalışmanın verileri yarı yapılandırılmış görüşmeler yoluyla elde edilmiş olup, çalışma kapsamında 19 katılımcı ile görüşme yapılmıştır. Katılımcı

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ABSTRACT

Results: A principal conclusion of this research is that hospital disaster planning should start at the development phase of the hospital and healthcare workers must get regular training to effectively react to crises and catastrophes across all tiers.

Conclusion: The research highlights the significance of proactive disaster planning in hospitals and the need to foresee coordination difficulties that may occur during extensive catastrophes.

Keywords: Disaster planning, earthquakes, emergency service, hospital

ÖZ

görüşmelerinin MAXQDA analiz programı ile kodlanması kriz yönetimi ve bireysel deneyim olmak üzere 2 tema altında toplanmıştır.

Bulgular: Bu çalışmanın en önemli çıktılarından biri deprem gibi can kaybına ve yaralanmaya neden olan afetler için hastane afet planlamasının hastanenin inşaat aşamasından itibaren başlaması ve sağlık çalışanlarının her ölçekteki acil durumlar ile afetlere hazırlıklı olması gerektiğidir.

Sonuç: Araştırma, hastanelerde proaktif afet planlamasının önemini ve felaketler sırasında ortaya çıkabilecek koordinasyon zorluklarını öngörme ihtiyacını vurgulamaktadır.

Anahtar Kelimeler: Afet planlaması, depremler, acil servis, hastane

Introduction

The frequency and severity of catastrophes are rising globally, underscoring the need for nations to improve their disaster planning and response capacities.

On February 6, 2023, two significant earthquakes, both originating in Kahramanmaraş, occurred within a 24-hour period, impacting almost 14 million people throughout many regions. Official records indicate that 53,537 individuals perished (1,2). The earthquakes highlighted the critical function of hospitals in delivering emergency healthcare services, both in the impacted area and in other provinces.

During significant natural catastrophes, the demand for medical services increases, exerting substantial strain on healthcare institutions. Hospitals are essential for preserving lives and providing care to wounded individuals. Consequently, all healthcare facilities must be equipped to manage large casualties and possess contingency plans to maintain operations when resources are strained. The capacity of a hospital to provide optimum patient care during catastrophes relies on efficient collaboration with other institutions and service providers (3).

Recent experiences have shown that inter-institutional coordination is as essential as guaranteeing hospitals provide safe patient care during crises. Hospital emergency management strategies must emphasize catastrophe resilience, guaranteeing that healthcare facilities remain functional and autonomous during crises (4). Notwithstanding insights gained from previous catastrophes and initiatives to enhance healthcare service standards, substantial deficiencies persist in the provision of competent healthcare services during emergencies.

Despite the abundance of literature on hospital disaster preparation and emergency response tactics, little research addresses the enhancement of communication, coordination, and reaction capabilities in hospitals impacted by disasters. Post-disaster phases can provide significant physical and psychological problems for healthcare practitioners (5).

The Kahramanmaraş earthquakes on February 6, 2023, significantly impacted people, especially healthcare professionals, who experienced personal losses and encountered substantial pressure to provide emergency treatment to victims of the calamity. Numerous healthcare workers encountered both sorrow and the need to guarantee an efficient medical reaction.

This research investigates the viewpoints of medical personnel at Kahramanmaraş Sütçü İmam University Faculty of Medicine about their experiences during the earthquakes of February 6, 2023. The aim is to ascertain essential preparations and priorities required for the continuous and efficient provision of healthcare services during emergencies.

Methods

Location of the Study

This study was conducted with volunteer healthcare workers at Kahramanmaraş Sütçü İmam University Faculty of Medicine, the epicenter of the earthquakes. This institution was chosen because it was directly affected by the disaster and played a crucial role in providing uninterrupted healthcare services during the crisis.

Sample of the Study

The study sample consisted of volunteer healthcare workers from Kahramanmaraş Sütçü İmam University Faculty of Medicine. Saturation is important in qualitative studies. Saturation is defined as continuing the research until no different data is obtained from the purposeful sampling methods (6). Data saturation occurs when no new or further insights emerge from the interviews, indicating that the sample size is sufficient (5). In this study, 19 participants (n=19) were interviewed, as the collected data reached a saturation point where further interviews did not yield additional information or new themes.

Hospitals are places where clinicians and non-clinical personnel work. As in normal times, these different disciplines need to work in harmony in times of disaster and emergency. The disruption of non-clinical activities also disrupts clinical services. It is necessary to experience these disruptions and needs, especially in

disaster situations. For this reason, all personnel of the hospital representing the sample of this study were included in the research.

Type of Research

This study employed purposive sampling, a method widely used in qualitative research. This sampling method involves identifying and selecting individuals or groups who are knowledgeable and experienced about the subject of interest (6). The goal was to explore how participants interpreted and made sense of their experiences during the earthquakes. Therefore, the study aimed to approach the topic from the participants' own viewpoints (7,8). The research utilized interviews and observations, which are standard qualitative research techniques. No exclusion criteria were determined other than data saturation for sample.

Implementation of the Research

Data collection was conducted between February 14 and 15, 2024. Each interview lasted between 10 and 30 minutes. Data were collected via voice recordings to ensure accuracy.

Before the interviews, participants were informed about the purpose and significance of the study. They were assured that the information provided would be used exclusively for research purposes and that they could withdraw from the interview at any time. Non-Interventional Clinical Research Ethics Committee of Kocaeli University approved the study (decision no: KOÜ GOKAEK-2024/04.34, number: E-80418770-020-563301, date: 08.03.2024). Verbal consent was obtained before proceeding.

The researchers created an open-ended question pool suitable for the purpose of the study and presented it to 3 experts. The following 6 non-directive questions were determined to be used in the interviews based on expert opinions.

1. Did you know the earthquake risk in the region you work/live in?

2. Did you have any individual or institutional preparations for a disaster of this scale? If so, can you provide brief information?

3. Do you have any training as a healthcare professional regarding what to do during and after a disaster? (If so, what kind of training did you receive?) If yes, to what extent were you able to apply this information on February 6?

4. Can you briefly describe what you experienced/felt as a healthcare professional who was affected by the earthquake? (What actions did you take to continue providing healthcare services, and did you experience any losses or damages during the earthquake?)

5. What were the problems you encountered while providing healthcare services?

6. Based on the incidents you experienced, do you have any suggestions to prevent these problems?

Statistical Analysis

The study used the content analysis method to examine the collected data. Content analysis involves systematically analyzing textual data, identifying patterns, and interpreting meanings within communication materials (9). This process consists of several stages, including defining objectives, identifying key concepts, determining units of analysis, extracting relevant data, developing a logical framework, establishing coding categories, analyzing frequency patterns, interpreting results, and drawing conclusions (10). To facilitate analysis, the MAXQDA 2020 qualitative data analysis software was used. This software enables researchers to efficiently process, code, and visualize qualitative data.

Before transferring the data to MAXQDA, the audio recordings were transcribed using a web-based transcription tool. The transcribed data were then reviewed separately by multiple researchers to ensure accuracy. Next, the transcribed text was imported into MAXQDA, where it was coded systematically.

Each interview was assigned specific coding keys, and as new codes emerged, previously coded transcripts were re-examined to refine the coding structure. This iterative approach minimized the risk of data loss during the analysis process (7).

Results

A total of 19 participants were interviewed for this study. Each participant's responses were anonymized and represented using the identifiers P1, P2, P3,… to maintain confidentiality.

Demographic Information

Table 1 presents the demographic characteristics of the 19 participants, including relevant variables such as age, gender, profession, and years of experience.

To maintain confidentiality, participant responses were anonymized and represented using the identifiers P1, P2, P3,….

Thematic Analysis

The qualitative data obtained from participant interviews were analyzed using the MAXQDA program. The findings were categorized under two main themes:

- Crisis Management
- Individual Experience

Each theme was further divided into categories with corresponding codes (Table 2). In total, 500 codes were generated, providing a comprehensive representation of participants' perspectives. Schematic representations of the hierarchical code-subcode model are presented in Figures 1 and 2.

Individual Experience Theme

Participants' opinions were grouped into three categories: earthquake knowledge and awareness, preparedness, and post-earthquake experiences. All participants reported awareness of the region's seismicity, yet stated that the earthquake exceeded

Table 1. Demographic data of participants

Interview	Gender	Age	Position / Department	Title	Marital status
P1	Male	40+	Anesthesiology and Reanimation	Doctor (Assoc. Prof.)	Married
P2	Male	40+	Cardiology	Doctor (Prof. MD.)	Married
P3	Male	40+	Physical Medicine and Rehabilitation	Doctor (Assoc. Prof.)	Married
P4	Female	30-40	Operating Theater	Nurse	Married
P5	Male	30-40	Information Technology	Engineer	Single
P6	Male	30-40	Chief Physician	Chief Manager	Married
P7	Male	20-30	Intensive Care Unit	Nurse	Married
P8	Male	20-30	Intensive Care Unit	Nurse	Married
P9	Male	40+	Emergency Medicine	Doctor	Married
P10	Female	30-40	Emergency Service	Charge Nurse	Married
P11	Female	30-40	Director of Nursing Services	Nurse	Married
P12	Female	20-30	Chief Pharmacist	Pharmacist	Married
P13	Female	40+	Anesthesia	Doctor	Married
P14	Male	40+	Orthopedics and Traumatology	Doctor	Married
P15	Male	30-40	Head Nurse	Nurse	Married
P16	Male	40+	Deputy Chief Physician	Doctor	Married
P17	Female	20-30	Anesthesiology and Reanimation	Assistant Doctor	Married
P18	Female	30-40	General Surgery	Nurse	Married
P19	Female	40+	Radiology	Doctor	Married

Table 2. Theme, category and code data of MAXQDA

Theme	Category	Sub-category		Participant opinions	
		Number	Percentage (%)	Number	Percentage (%)
Crisis management	Problems and difficulties during and after the earthquake	48	22.64	133	26.33
	Positive situations during and after the earthquake	22	10.37	93	18.41
	Institutional preparation before earthquake	13	6.13	41	8.11
	Healing - regulatory suggestions	49	23.11	107	21.18
Individual experience	Earthquake information - awareness - preparation	9	4.2	50	9.90
	Positive situations after the earthquake	7	3.30	12	2.37
	Adverse situations after the earthquake	64	30.18	64	12.67
Total sub-category / code		212		500	

expectations. They indicated that they followed news sources on the anticipated earthquake and safe zones, considered seismic risk when choosing residences, and made limited preparations, often neglecting drills and comprehensive measures.

Positive aspects highlighted were strong solidarity among colleagues, adequate provision of basic needs (food, clean water, sanitation), and safe areas for family members within the hospital. Conversely, some participants noted difficulties such as unmet basic needs, hygiene problems, and feelings of loneliness and abandonment in the first 24 hours. All participants expressed grief over the loss of colleagues and relatives, and emphasized the strain of working while being victims themselves. Seasonal hardships, limited social awareness, and challenges faced by female staff in balancing family responsibilities while on duty were also underscored.

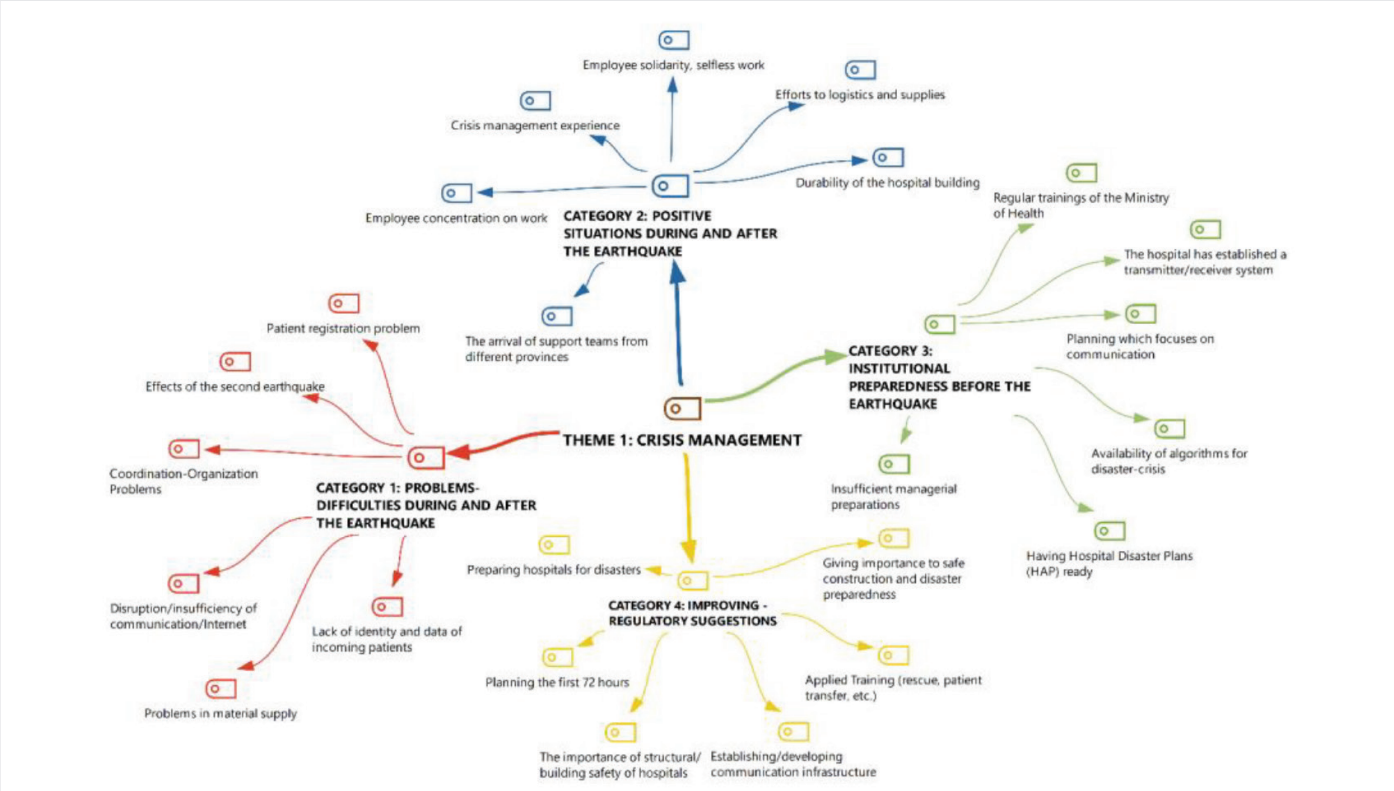

Figure 1. Crisis management theme code-subcode model

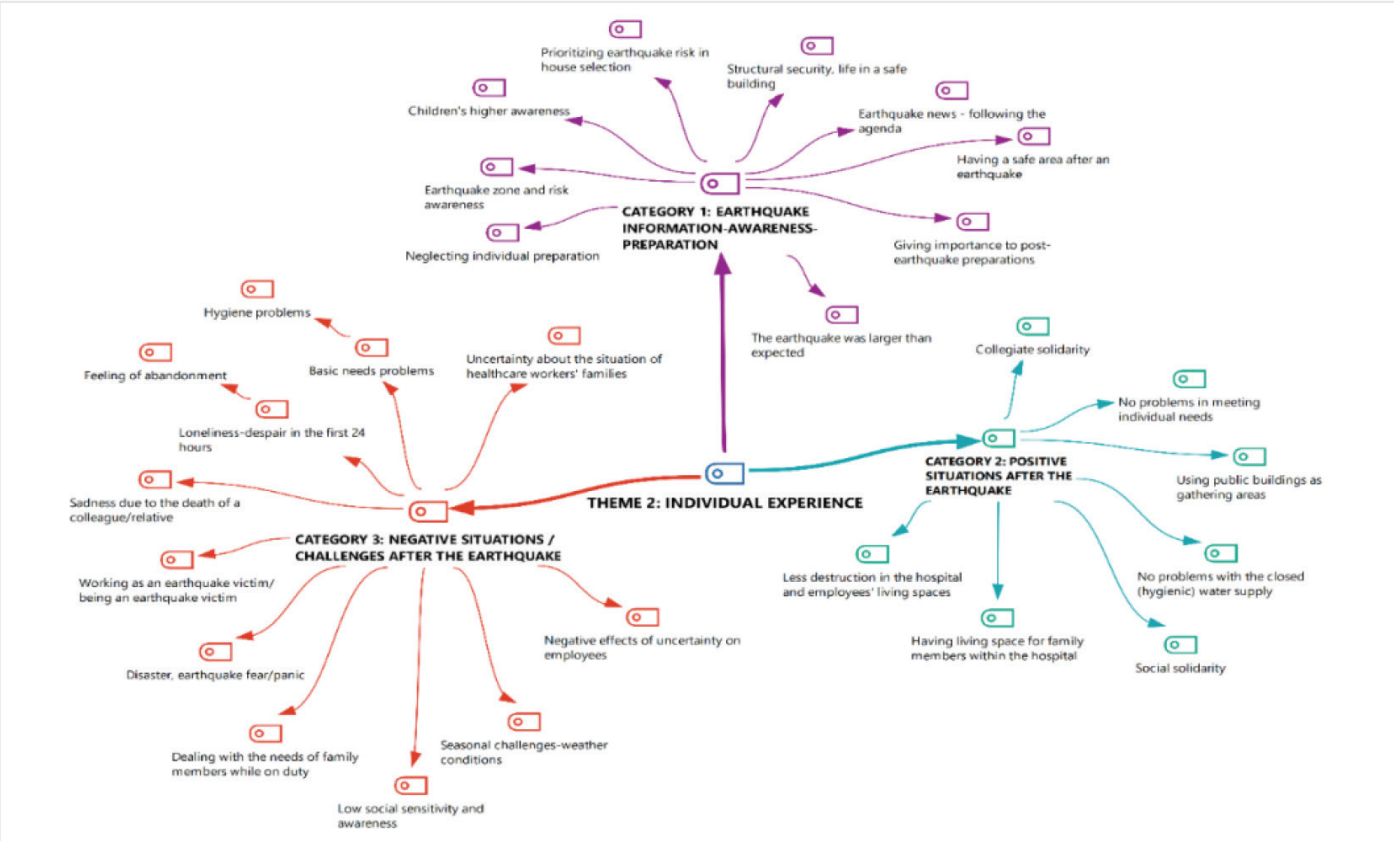

Figure 2. Individual experience theme code-subcode model

Crisis Management Theme

Nineteen participants reported issues primarily categorized as problems, challenges, and remedial suggestions during and after the earthquake (Table 2). The main difficulties included patient registration problems, lack of patient identity data, poor coordination and organization, communication breakdowns, material shortages, and the disruptive impact of the second earthquake occurring on the same day. These deficiencies revealed that disaster response proved insufficient in terms of health system planning.

Other challenges involved the overwhelming patient influx in the first 24 hours, delays in external team and material support due to winter conditions, and difficulties in team coordination. Hospital damage during the second earthquake further weakened medical capacity, especially regarding hygiene and sterilization.

Despite these constraints, participants reported high motivation, solidarity, and dedication in maintaining healthcare services. They recommended that hospital infrastructure be strengthened with earthquake-resistant design, communication systems be established with disaster-oriented planning, and the first 72 hours be organized with realistic self-sufficiency in mind. Furthermore, hospital disaster plans (HDP) and training content should be updated for practical, large-scale disaster scenarios.

Discussion

The 1999 earthquakes and the process that followed revealed many deficiencies in Türkiye's disaster management. These deficiencies observed in the disaster area and specific to the disaster revealed the need for coordination and organization in Türkiye's disaster management, especially in the response process. The heavy damage suffered in the 2023 earthquakes created discussions about whether these deficiencies were remedied. Some studies evaluating the development of Türkiye's disaster response capacity after the 2023 earthquakes described the earthquakes as seismic events that tested and shaped Türkiye's disaster management strategies (11).

The "Emergency Medicine Specialists Field Observation Report 2023" by the Turkish Association of Emergency Medicine Specialists highlighted several critical issues on the initial day of the earthquakes: inadequate preparedness for earthquake zone assessments, insufficient coordination, transportation constraints, and a deficiency in essential equipment, materials, and personnel within the affected area (12,13). A significant number of the concerns highlighted in the report coincide with the results of our investigation.

Following the first day, most volunteer health teams were unable to reach the earthquake zone due to damage to highways caused by the earthquake, poor winter road conditions, and a significant presence of private cars. Numerous routes were evaluated for road transportation; however, most of these routes lacked access to the area. The highway routes were often altered based on the data acquired from the area. Within the first 24 hours post-earthquake, military and civilian evacuation planes were used to convey persons to the impacted areas. Most airports in the earthquake zones incurred substantial damage within 20 hours of the seismic event. In the subsequent days, there was a deficiency of healthcare personnel in the disaster-affected areas due to the tragic loss of lives, families, or homes among many healthcare workers in those regions. The lack of cooperation in the disaster-affected regions, together with the approach of winter, obstructed the prompt arrival of external health personnel.

Furthermore, this research indicated that regional communication, particularly internet-mediated services, which were disrupted by structural damage and power outages resulting from the earthquake, could only be restored partly and regionally by the end of the first day. Hospital information management systems (HIMS) facilitate patient registration and identification, generate forensic reports, issue death notifications, conduct consultation processes, produce burial certificates, and schedule exams. Subsequent to the earthquake, the internet and energy infrastructures were compromised, particularly in the municipalities of Hatay, Adıyaman, and Kahramanmaraş, resulting in the inability to conduct patient transactions via the HIMS. Communication inside the same institution was fraught with problems, achievable alone via individual effort. Notification systems were reported as disabled, resulting in difficulties in identifying the deceased and wounded.

Disel et al. (14) did research examining the impact of the February 6, Kahramanmaraş earthquakes on patient outcomes. Their work, "Factors Affecting the Mortality of February Earthquake Victims in Türkiye", significantly contributes to the literature on disaster medicine.

This study revealed a notably innovative and alarming finding: unidentified patients face increased risks, including higher instances of entrapment under debris, classification with a red triage code, the need for hemodialysis, emergency surgical procedures, and elevated mortality rates relative to other groups.

Disaster victim identification is an essential component of handling casualties in the domain of disaster science. This includes immediate medical care, advanced treatments like dialysis and surgery, and the creation of transfer systems.

Azarmi et al. (15) asserted that senior managers regard preventive planning and risk preparedness as critical elements of hospital disaster management, advocating for comprehensive studies that encompassed all hazards, stages, and levels of disaster risk management. The study examined the challenges faced in hospital disaster risk management, categorized into technical-physical, organizational-managerial barriers (including planning, surge capacity, communication, coordination, and regulatory compliance), financial barriers (encompassing budget, political will and commitment, cultural factors, motivation, and knowledge), and human barriers (covering training and exercises, commitment, motivation, cultural influences, and personnel shortages). These results aligned precisely with the perspectives of the participants in the current

research (15). Melnychuk et al. (16) examined the adverse conditions encountered in hospitals affected by disasters, categorizing them as power outages, loss of heating, ventilation, and air conditioning, fluctuations in temperature and air quality, loss of health information and technology, communication failures, workforce reductions, material shortages (disruptions in logistics and supply chain management), vulnerabilities, and both structural and non-structural damages. The titles corresponded with the themes articulated by participants in our research on the adverse circumstances they encountered during and after the tragedy (16). Adelaine et al. (4) asserted in their research that a hospital's capacity to provide optimal patient care during emergencies depends on its proficiency in coordinating with other institutions and service providers, highlighting the impracticality of depending on such partnerships in crisis situations. This discovery corroborated the coordination experiences of our participants (4).

Study Limitations

In this study, Kahramanmaraş Sütçü İmam University Faculty of Medicine Hospital employees were asked about their experiences and behaviors immediately after the February 06, 2023 earthquakes. These behaviors might not be representative of all employees. Therefore, the results could not be generalized.

Conclusion

Earthquakes are occurrences that impact communities, resulting in loss of life, but also enhancing the resilience of the affected community for future disasters. The Kahramanmaraş earthquake on February 6, 2023, resulted in significant devastation and fatalities in our nation. The extent of the impact zone of the event, the significant effects on adjacent provinces comparable to the epicenter, delays in response attributable to meteorological conditions, and, crucially, the coordination challenges encountered due to the unprecedented scale of the disaster, underscore the necessity for enhancements in our nation's disaster management system and HDP. A key finding of this study is that hospital disaster planning must commence during the construction phase to address disasters that result in fatalities and injuries, such as earthquakes, and healthcare professionals should be equipped to handle emergencies and disasters of all magnitudes. During a disaster, there is a sudden increase in hospital load. One of the most important steps that prevents hospitals from responding effectively to disasters is the sudden increase in capacity known as surge capacity. In disaster preparations, HDP based on scenarios specific to different events such as simulations, incident command systems, disaster triage, epidemic disease interventions, decontamination, mass incident management, surge capacity, and terror-war situations, should be prepared to cover all hazards and all stages of disaster management and supported with training and drills.

Ethics

Ethics Committee Approval: Non-Interventional Clinical Research Ethics Committee of Kocaeli University approved the study (decision no: KOÜ GOKAEK-2024/04.34, date: 08.03.2024).

Informed Consent: Verbal consent was obtained before proceeding.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: S.G., A.Y., S.Y., Ç.Ç., Concept: S.G., A.Y., Design: S.G., Data Collection or Processing: A.Y., S.Y., Ç.Ç., Analysis or Interpretation: S.Y., Ç.Ç., Literature Search: S.G., S.Y., Writing: S.G., S.Y.

Conflict of Interest: No conflict of interest was declared by the authors.

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Original Article

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Effects of *Momordica charantia* on Gastritis

Momordica charantia'nın Gastrit Üzerine Etkisi

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ABSTRACT

Objective: Gastritis is a significant global health concern caused by various factors and associated with considerable morbidity if not properly managed. Oxidative stress and proinflammatory cytokines are known to play critical roles in gastric mucosal injury and disease progression. Although *Momordica charantia (M. charantia)* is recognized for its antioxidant, anti-inflammatory, and gastroprotective properties, its therapeutic role in experimental gastritis models has not been comprehensively investigated. This study aimed to evaluate the efficacy of appropriately formulated *M. charantia* in ethanol-induced gastritis in rats, using detailed biochemical and histopathological assessments. **Methods:** Experimental gastritis was induced in male Sprague-Dawley rats via intragastric administration of 80% ethanol (5 mL/kg). Rats were randomized into control and treatment groups receiving *M. charantia* extract, proton pump inhibitors (PPI), or a multi-herbal capsule compound for 14 days. Biochemical analyses measured total antioxidant status, total oxidant status, oxidative stress index, and proinflammatory cytokines [interleukin (IL)-1β, IL-6, tumor necrosis factor-α, transforming growth factor-β] in serum and gastric tissues. Histopathological examinations assessed mucosal damage, inflammatory cell infiltration, ulceration, and the presence of *Helicobacter pylori*. **Results:** *M. charantia*-treated rats demonstrated significantly reduced oxidative stress markers and lower levels of inflammatory cytokines compared to the ethanol-only group ($p<0.05$). Histopathological analyses revealed reduced mucosal damage, less edema, and decreased inflammatory infiltration in the *M. charantia* group. The therapeutic efficacy of *M. charantia* was comparable to

ÖZ

Amaç: Gastrit, multifaktöriyel etiyolojisi ve tedavi edilmediğinde yol açtığı ciddi komplikasyonlarla, dünya genelinde önemli bir sağlık sorunu olmaya devam etmektedir. Son yıllarda oksidatif stresin ve proenflamatuvar sitokinlerin, gastrik mukoza bütünlüğünün bozulmasında ve hastalığın ilerleyişinde merkezi roller üstlendiği gösterilmiştir. *Momordica charantia (M. charantia)*, antioksidan, anti-enflamatuvar ve gastroprotektif özellikleriyle dikkat çekmektedir. Ancak, bu bitkinin deneysel gastrit modellerindeki terapötik etkinliği, detaylı biçimde araştırılmamıştır. Yaptığımız bu çalışmada, uygun şekilde formüle edilmiş *M. charantia*'nın etanol ile indüklenen rat gastriti üzerindeki etkinliğini, detaylı biyokimyasal ve histopatolojik değerlendirmelerle incelemeyi amaçlamıştır. **Yöntemler:** Deneysel gastrit, erkek Sprague-Dawley ratlarına intragastrik yolla %80 etanol (5 mL/kg) uygulanarak indüklenmiştir. Ratlar, kontrol ve tedavi gruplarına rastgele dağıtılmış ve 14 gün boyunca *M. charantia* ekstresi, proton pompa inhibitörleri (PPI) veya çoklu bitkisel kapsül bileşimi ile tedavi edilmiştir. Biyokimyasal analizlerde serum ve gastrik dokularda toplam antioksidan düzeyi, toplam oksidan düzeyi, oksidatif stres indeksi ve proenflamatuvar sitokinler [interlökin (IL)-1β, IL-6, tümör nekroz faktörü-α, transforme edici büyüme faktörü-β] ölçülmüştür. Histopatolojik incelemelerde mukozal hasar, enflamatuvar hücre infiltrasyonu, ülserasyon ve *Helicobacter pylori* varlığı değerlendirilmiştir. **Bulgular:** *M. charantia* ile tedavi edilen ratlarda, yalnızca etanol uygulanan grupla karşılaştırıldığında, oksidatif stres belirteçleri ve enflamatuvar sitokin düzeyleri anlamlı derecede düşük bulunmuştur ($p<0,05$). Histopatolojik analizlerde *M. charantia* grubunda mukozal hasarın, ödemin ve enflamatuvar

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ABSTRACT

PPI in most histological outcomes, although prevention of intestinal metaplasia was less pronounced in groups without PPI treatment. **Conclusion:** This study indicates that *M. charantia* effectively mitigates gastric mucosal injury by enhancing mucosal defenses and reducing oxidative stress and inflammation. To our knowledge, such detailed evaluation of *M. charantia* in gastritis has not been previously reported, highlighting the novelty of these findings. Phytotherapeutic agents like *M. charantia* may offer safe and effective adjuncts or alternatives to standard therapies, contributing to improved management of gastritis and gastric ulcers.

Keywords: Gastritis, *Momordica charantia*, ethanol, oxidative stress, rat model

ÖZ

infiltrasyonun azaldığı gözlenmiştir. *M. charantia*'nın terapötik etkinliği, histolojik parametrelerin çoğunda PPI ile karşılaştırılabilir bulunmuş, ancak intestinal metaplazi önlenmesi, PPI uygulanmayan gruplarda daha az belirgin olmuştur. **Sonuç:** Yapılan bu çalışma, *M. charantia*'nın gastrik mukoza hasarını azaltmada, mukozal savunmayı güçlendirerek ve oksidatif stres ile enflamasyonu düşürerek etkili olduğunu göstermektedir. Bilindiği kadarı ile gastritte *M. charantia*'nın detaylı değerlendirmesi literatürde daha önce raporlanmamıştır ve bulguların değerini ortaya koymaktadır. *M. charantia* gibi fitoterapötik ajanlar, gastrit ve gastrik ülserlerin tedavisinde standart tedavilere güvenli ve etkili bir yardımcı veya alternatif seçenek sunabilir ve hastalık yönetimine katkı sağlayabiliceği düşünülmektedir.

Anahtar Kelimeler: Gastrit, *Momordica charantia*, ethanol, oksidatif stress, sıçan modeli

Introduction

Gastritis is a chronic, global health issue associated with various etiologies, leading to serious complications in the long term. It can develop due to various etiologies and, if left untreated, can be associated with serious long-term complications (1). Based on the pathology and course of the disease, different classification definitions exist, but it is commonly classified as acute and chronic gastritis. Acute gastritis is typically triggered by factors such as irritating foods, medications, chemical corrosive substances, bacterial infections, and stress reactions. On the other hand, chronic gastritis has a much more complex etiology and mechanisms and is often multifactorial (2). The gastric mucosa is remarkably resistant to self-digestion by hydrochloric acid and pepsin due to protective barrier mechanisms; however, disruption of these defenses can lead to gastritis and ulcer formation. Some important elements of gastric barrier mechanisms are listed in Table 1. When this defense mechanism is compromised, gastritis and gastric ulcer formation occur (3).

Among the principal factors contributing to gastric mucosal damage are reactive oxygen species (ROS) and proinflammatory cytokines, which play pivotal roles in the initiation and progression of gastritis. Excessive ROS production, triggered by infections such as *Helicobacter pylori* (*H. pylori)* or various stressors, can overwhelm endogenous antioxidant systems, leading to lipid peroxidation, protein oxidation, and DNA damage within gastric epithelial cells. Elevated levels of ROS, coupled with the release of inflammatory cytokines—including interleukin (IL)-1β, IL-6, tumor necrosis factor (TNF)-α, and transforming growth factor (TGF)-β1—sustain chronic inflammation and disrupt mucosal integrity, thereby increasing susceptibility to further injury and contributing to disease progression and potential neoplastic transformations (4-6). Despite the availability of pharmacological treatments, the high rates of recurrence and adverse effects associated with long-term conventional therapy highlight the urgent need for alternative therapeutic strategies.

Table 1. Factors associated with gastric barrier function and cell protection (3)

Components	Mediators
Mucosal barrier	Prostaglandins
Bicarbonate secretion	Nitric oxide
Epithelial barrier Hydrophobic phospholipids Tight junctions Repair	Epidermal growth factor Calcitonin gene-related peptide Hepatocyte growth factor Histamine gastrin-releasing peptide
Microcirculation (reactive hyperemia)	
Afferent sensory neurons	

In recent years, phytotherapeutic agents derived from medicinal plants have attracted considerable interest as potential alternatives for managing gastritis due to their natural origin, lower toxicity profiles, and diverse bioactive compounds. *Momordica charantia (M. charantia)*, widely used in traditional medicine systems, is known for its antioxidant, anti-inflammatory, antidiabetic, and gastroprotective properties. Phytochemical analyses have revealed that *M. charantia* contains bioactive compounds such as flavonoids, triterpenes, and saponins, which exhibit significant free radical scavenging activity and modulate inflammatory pathways (7). *M. charantia* has attracted considerable scientific interest due to its diverse pharmacological properties, including immunostimulatory, anti-inflammatory, antioxidant, cardioprotective, and hypoglycemic effects. Previous studies have demonstrated that *M. charantia* effectively scavenges hydroxyl radicals and superoxide anions, contributing to its significant antioxidant activity. Furthermore, it has been shown to inhibit proinflammatory cytokines such as TNF-α and IL-6, reduce intracellular oxidative stress, enhance endogenous antioxidant enzyme activity, and promote mucosal healing, thereby exhibiting potential therapeutic benefits in various inflammatory and oxidative stress-related conditions.

These properties suggest that *M. charantia* may offer protective effects against gastric mucosal injury by attenuating oxidative stress and inflammatory responses. Experimental studies suggest that *M. charantia* exerts significant anti-gastritis effects by strengthening the gastroprotective barrier through anti-inflammatory, antioxidative, and mucosal protective mechanisms, while olive oil-based formulations may enhance its bioavailability. However, despite its recognized pharmacological activities, there is a paucity of research specifically investigating the efficacy of appropriately formulated *M. charantia* preparations in experimental models of gastritis, leaving a significant gap in the current understanding of its therapeutic potential in this context (8,9).

Therefore, this study aimed to evaluate the effects of appropriately formulated *M. charantia* treatment on experimental gastritis in rats by assessing various biochemical markers of oxidative stress and inflammation parameters, as well as conducting detailed histopathological analyses. This research aims to provide new insights into the potential role of *M. charantia* as a natural therapeutic agent for the prevention and management of gastritis, an area for which limited research currently exists in the literature.

Methods

Experimental Procedure

Ethical approval for animal experimentation was obtained from the Local Ethics Committee for Animal Experiments for the Gastritis Model Animal Experimental Study at Bezmialem Vakıf University (decision no: 2022/06, date: 24.01.2022). Detailed experimental procedures are presented in Figure 1. Prior to the study, approximately 25 male Sprague-Dawley rats of similar age were acclimatized to the laboratory environment for two weeks. During this acclimatization period, the rats were housed in standard cages under a 12-hour light / dark cycle at a controlled room temperature of 22-25 °C. They were provided with a pellet diet and ad libitum access to water. Before the experiments commenced, the body weights of all animals were recorded, and the rats were randomly assigned to control and experimental groups. All groups were fasted for 24 hours prior to the start of the experimental procedures, while water remained available without restriction. All experimental protocols and animal care practices complied with current standards for the ethical treatment of laboratory animals.

Eighty percent ethanol (C2H5OH) was administered to rats at a dose of 5 mL/kg via intragastric route using oral gavage and 4 hours later, a gastritis-gastric ulcer model was established in accordance with the literature (10). Group 1 was exposed to similar stress by administering the same volume of distilled water via oral gavage. In Group 3, olive oil-based extracts of *M. charantia*, known for their high bioavailability, were preferred for treatment (11). The treatment duration was set at 14 days, consistent with previous studies, and each treatment administered to the groups was given orally via gavage in a similar manner (12). After creating the models in rats and treating them with different methods according to their groups for 14 days, the rats were sacrificed by using 90 mg/kg of ketamine (Ketalar®, Pfizer Pharma GMBH, Germany) and 10 mg/kg of xylazine hydrochloride (Alfazyne®, 2%, Alfasan International, 3440 AB, Woerden, Holland) anesthesia. Bloods were collected and then midline incision was made between the sternum and anus to reach the gastric region. Total gastrectomy was performed. Tissue sections were then separated for histopathological and biochemical evaluation. Samples of blood, serum, and gastric tissue were stored under laboratory conditions at -80 degrees Celsius.

The following parameters were recorded in the blood samples among the groups: white blood cells (2.1-19.5×10^9 cells/uL),

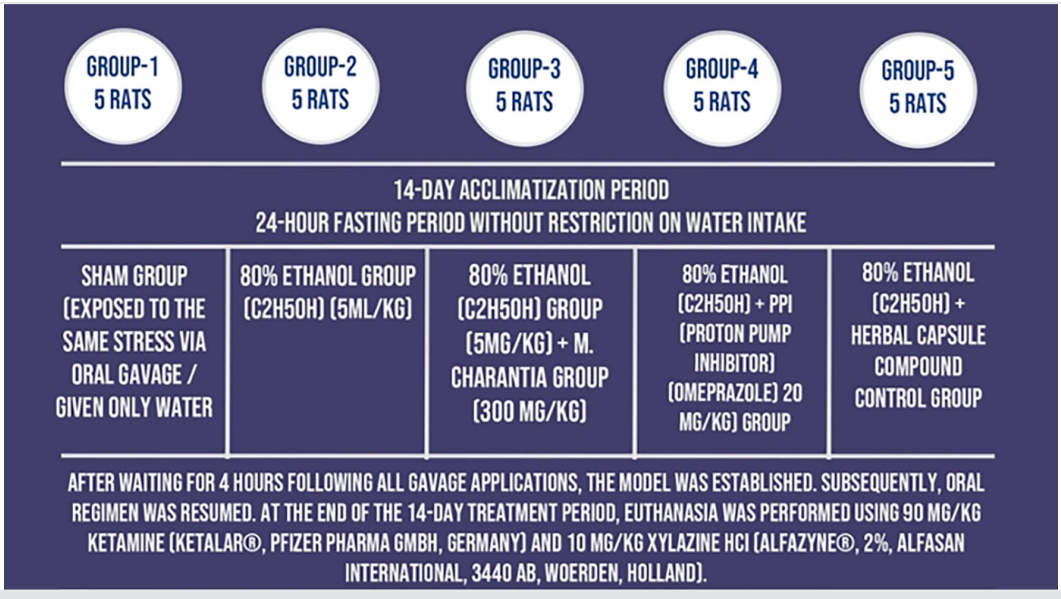

Figure 1. Graphical abstract of experimental procedure & 8195
M. Charantia: Momordica charantia

lymphocytes (2-14.1×10^9 cells/uL), monocytes (MONO) (0-0.098×10^9 cells/uL), granulocytes (GRA) (0.1-5.4×10^9 cells/uL), red blood cells (5.3-10×10^12 cells/uL), hemoglobin (HGB) (14-18 g/dL), hematocrit (35-52%), mean corpuscular volume (50-62 fl), mean corpuscular hemoglobin (MCH) (16-23 pg), MCH concentration (MCHC) (31-40 g/dL), red cell distribution width %, platelet (500-1370×10^9 cells/uL), plateletcrit %, mean platelet volume (fl), platelet distribution width %, hemoglobin A1c %, total antioxidant status (AU), total oxidant status (AU), IL-1β, TNF-α (pg/mL), oxidative stress index (AU), IL-6, and TGF-β. Similarly, biochemical analyses were performed on stomach tissue samples obtained from the rats, and the results were recorded. The excised stomach tissue from the sacrificed rats was dissected along the greater curvature for macroscopic evaluation. It was then sent for light microscopic examination at our pathology department. Tissue samples were fixed in 10% neutral buffered formaldehyde prepared in phosphate-buffered saline for 1 day. After washing the stomach samples with 0.9% isotonic sodium chloride (Polyflex, Polifarma, Tekirdağ, Türkiye), examinations were conducted to determine macroscopic gastric damage and, if present, ulceration areas. Sections of tissues prepared using the hematoxylin and eosin staining method were examined under a light microscope. Various parameters such as edema, chronic inflammation, presence of lymphoid follicles, prevalence of gastritis, erosion extent, ischemic necrosis, inflammation activity, and bleeding were evaluated among the groups. The sections were compared between groups, and the results were recorded. Histopathological presence of *H. pylori* was investigated using the Giemsa staining technique. Additionally, the presence of intestinal metaplasia in tissues was evaluated using the periodic acid-Schiff staining technique. All evaluations were repeated at least two times. Experimental models of gastritis were established in rats using various protocols, including non-steroidal anti-inflammatory drugs (NSAIDs)-induced, stress-related, alcohol-associated, and congestive gastropathy models, each reflecting distinct pathophysiological mechanisms and enabling the investigation of gastric mucosal injury (13).

Statistical Analysis

Due to the sample size (n<30) in each group, the normal distribution of variables was not assessed. Continuous variables were expressed as median (interquartile range) [Q2(Q1:Q3)], while categorical variables were expressed as n (%). Kruskal-Wallis H test was used for comparisons between more than two groups of variables. Fisher-Freeman-Halton test was employed for comparing categorical variables. Bonferroni correction was applied for comparisons showing significant differences between groups. Statistical analysis was conducted using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA), and p<0.05 was considered statistically significant.

Herbal capsule compound - (G-Two® PolyPhyto Polymer Health E.M.T, İstanbul, Türkiye - olive leaf extract 250 mg, *M. charantia* extract 200 mg, *Garcinia cambogia* extract 150 mg, cinnamon 100 mg, L-carnitine 50 mg, chromium 100 μg) and its effects on gastritis.

Olive leaf extract is known to contain bioactive phenolic compounds, while *Garcinia cambogia*, cinnamon, L-carnitine, and chromium are included for their various biological properties. In this study, the effects of *M. charantia* on gastritis were investigated through biochemical assessments of oxidative stress and inflammatory cytokines, along with histopathological analyses (14,15).

Results

Statistical analysis of hemogram results among groups is presented in Table 2. Statistically significant differences were observed between groups in MONO-count (×10^9 cells/μL), GRA count (×10^9 cells/μL), MONO percentage (%), HGB (g/dL), and MCHC (g/dL) values [p<0.05 (p<0.05)]. Upon examination of Table 3 statistically significant differences were observed between groups in terms of biochemical parameters in blood values and enzyme-linked immunosorbent assay (ELISA) analyses (p<0.05). Similarly, significant differences were found between groups in the statistical evaluations of biochemical parameters in tissue examinations and ELISA analyses (p<0.05) (Table 4).

Table 2. Analysis of hemogram results among groups

Variables	Group 1 sham group	Group 2 80% ethanol (C2H5OH)	Group 3 80% ethanol (C2H5OH) + *Momordica charantia*	Group 4 80% ethanol (C2H5OH) + PPI	Group 5 80% ethanol (C2H5OH) + herbal capsule compound	p[a] value
Weight (gr)	340 [317.5:360]	325 [317.5:352]	325 [312.5:337.5]	325 [312.5:337.5]	325 [315:337.5]	0.757
WBC	6.53 [4.67:7.95]	8.6 [7.41:9.91]	6 [5.22:9.53]	6.34 [5.37:17.66]	7.97 [5.27:9.57]	0.497
LYM (2-14.1 10*9 uL)	4.64 [3.81:6.88]	5.40 [4.49:6.82]	4.59 [3.43:8.03]	4.96 [3.56:8.86]	6.35 [4.21:8.19]	0.905
MONO (0-0.098 10*9 uL)	0.07 [0.05:0.71]	0.06 [0.05:0.62]	0.17 [0.13:0.54]	0.50 [0.24:1.24]	0.16 [0.14:0.28]	**0.046**
GRA (0.1-5.4 10*9 uL)	1.80 [1.20:1.91]	1.92 [1.77:2.05]	1.30 [1.14:1.45]	1.57 [1.15:7.45]	1 [0.79:1.46]	**0.024**
LYM (55-97%)	76.4 [72:78.1]	72 [65.3:74.3]	76.6 [65.9:84.5]	74.4 [48.6:78.6]	83.4 [74.5:86.2]	0.161
MONO (0-5%)	1.1 [0.7:1.35]	7 [5:7]	1.8 [1.65:10.15]	7.4 [3.1:9.7]	1.9 [1.7:5.3]	**0.014**
GR (2-31%)	23 [19.7:26.5]	23 [20.5:29.5]	21.7 [13.9:24]	20.7 [16.9:41.8]	14.9 [11.15:21.05]	0.204
RBC (5.3-10 10* 12 uL)	8.26 [7.58:8.38]	8.2 [7.68:8.59]	8.05 [4.08:8.37]	7.82 [7.67:7.90]	8.48 [8.29:8.63]	0.110

Table 2. Continued

Variables	Group 1 sham group	Group 2 80% ethanol (C2H5OH)	Group 3 80% ethanol (C2H5OH) + *Momordica charantia*	Group 4 80% ethanol (C2H5OH) + PPI	Group 5 80% ethanol (C2H5OH) + herbal capsule compound	p[a] value
HGB (14-18 g/dL)	14.5 [14.2:14.8]	14.4 [14.2:14.6]	14.8 [13.85:15.05]	13.4 [12.8:13.85]	14.4 [14.1:14.95]	**0.026**
HCT (35-52%)	40 [37.8:41.25]	40 [38.5:40.7]	41.07 [38.26:42.27]	38.3 [36.2:39.15]	39.4 [39.05:42.1]	0.241
MCV (50-62 fl)	49 [48:54]	50 [41.5:51.5]	49 [48:50.5]	49 [47:50]	47 [46.5:49]	0.441
MCH (16-23 pg)	17.8 [17.6:18.35]	18.2 [17.2:18.85]	17.8 [17.35:18.1]	17.2 [16.55:17.65]	17 [16.9:17.4]	0.052
MCHC (31-40 g/dL)	36.7 [35.05:36.75]	36.5 [36.2:36.25]	36.2 [35.5:36.25]	35 [34.75:35.9]	36 [35.5:36.35]	**0.043**
RDW c %	16.8 [16:17.15]	16.9 [16.55:17.2]	16.2 [16.2:16.65]	17.1 [17.05:17.5]	16.5 [16.5:17.45]	0.049
PLT (500-1370 10*9 uL)	917 [879:1186]	934 [891:991]	943 [865:1025]	846 [838.5:912]	867 [628.5:956]	0.287
PCT %	0.67 [0.55:0.88]	0.65 [0.53:0.73]	0.64 [0.58:0.69]	0.59 [0.59:0.62]	0.60 [0.45:0.66]	0.528
MPV (fl)	7.3 [6.3:7.4]	7.1 [6.95:7.55]	6.8 [6.6:6.85]	7 [6.65:7.1]	6.9 [6.7:7.25]	0.257
PDWc %	34.8 [33.45:35.8]	34.5 [33.2:36.05]	33.8 [33.05:34]	35 [33.95:35.35]	34.8 [34.15:36.3]	0.231

The significance level was set at p<0.05
Q2 [Q1:Q3] was used for defining the variables
[a]: Kruskal-Wallis test, WBC: White blood cells, LYM: Lymphocytes, MONO: Monocytes, GRA: Granulocytes, RBC: Red blood cell, HGB: Hemoglobin, HCT: Hematocrit, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration, RDW: Red cell distribution width, PLT: Platelet, PCT: Plateletcrit, MPV: Mean platelet volume, PDWc: Platelet distribution width

Table 3. Biochemical parameters in blood values and ELISA analyses among groups

Variables	Group 1 sham group	Group 2 80% ethanol (C2H5OH)	Group 3 80% ethanol (C2H5OH) + *Momordica charantia*	Group 4 80% ethanol (C2H5OH) + PPI	Group 5 80% ethanol (C2H5OH) + herbal capsule compound	p[a] value
TAS	0.33 [0.32:0.37]	0.17 [0.15:0.18]	0.27 [0.24:0.28]	0.31 [0.27:0.33]	0.22 [0.20:0.25]	**<0.001**
TOS	1.78 [1.59:1.88]	2.82 [2.52:2.99]	2.36 [2.2:2.45]	2.02 [1.99:2.16]	2.5 [2.44:2.63]	**<0.001**
IL1β	96.06 [91.21:102.36]	265.6 [260.3:274.6]	195.4 [179.9:205.5]	144.7 [12.3:158.4]	217.2[213.7:239.7]	**<0.001**
OSI	5.12 [4.64:5.59]	16.51 [14.56:19.22]	8.83 [8.46:9.31]	6.98 [6.31:7.32]	11.06 [9.69:12.96]	**<0,001**
IL-6	49.11 [48.08:52.73]	163.9 [123.6:175.4]	113.7 [101.6:115.6]	79.57 [74.04:85.24]	127.6 [123.3:147,6]	**<0.001**
TNF-α (pg/mL)	87.01 [83.3:97.3]	214.2 [183.5:227.4]	129.5 [121.1:140.7]	109.1 [101.8:119.9]	172.3 [154.2:183.6]	**<0.001**
TGF-β	52.2 [50.04:55.79]	106.5 [101.5:118.02]	76.8 [70.4:82.6]	69.03 [56.12:73.89]	80.65 [76.65:86.8]	**0.001**

Variables were defined using Q2[Q1:Q3]
[a]: Kruskal-Wallis test, ELISA: Enzyme-linked immunosorbent assay, PPI: Proton pump inhibitor, TAS: Total antioxidant status, TOS: Total oxidant status, IL: Interleukin, OSI: Oxidative stress index, TNF-α: Tumor necrosis factor alpha, TGF-β: Transforming growth factor beta

Table 4. Biochemical parameters in tissue examinations and ELISA analyses among groups

Variables	Group 1 sham group	Group 2 80% ethanol (C2H5OH)	Group 3 80% ethanol (C2H5OH) + *Momordica charantia*	Group 4 80% ethanol (C2H5OH) + PPI	Group 5 80% ethanol (C2H5OH) + herbal capsule compound	p[a] value
TAS	0.42 [0.39:0.43]	0.14 [0.11:0.16]	0.25 [0.23:0.29]	0.31 [0.29:0.33]	0.19 [0.17:0.23]	**<0.001**
TOS	0.31 [0.28:0.34]	0.72 [0.71:0.78]	0.49 [0.46:0.52]	0.46 [0.39:0.48]	0.60 [0.55:0.64]	**<0.001**
IL-1β	207.8 [204.7:22.3]	370.9 [356.9:382.3]	302.1 [300.8:315.9]	279.01 [269.7:287.05]	324.5 [312.9:359.7]	**<0.001**
OSI	0.79 [0.67:0.82]	5.88 [4.57:6.43]	1.86 [1.7:2.14]	1.42 [1.23:1.63]	3.18 [2.46:3.64]	**<0.001**
IL-6	102.7 [50.12:107.5]	234.7 [227.6:253.9]	175.1 [166.7:183.1]	143.9 [130.2:152.8]	198.6 [190.8:207.8]	**<0.001**
TNF-α (pg/mL)	191.4 [170.3:205.8]	270.8 [257.2:280.8]	224.9 [215.4:243.3]	219.3 [198.9:230.4]	247.1 [225.1:262.6]	**0.001**
TGF-β	171.4 [147.5:184.6]	275.6 [256.1:297.1]	223.9 [217.8:227.2]	203.4 [199.7:210.2]	229.2 [217.2:261.6]	**<0.001**

Variables were defined using Q2 [Q1:Q3]
[a]: Kruskal-Wallis test, ELISA: Enzyme-linked immunosorbent assay, PPI: Proton pump inhibitor, TAS: Total antioxidant status, TOS: Total oxidant status, IL: Interleukin, OSI: Oxidative stress index, TNF-α: Tumor necrosis factor alpha, TGF-β: Transforming growth factor beta

Upon examination of Table 5, when histopathological response findings to treatments were evaluated, it was observed that there was a significant difference in terms of frequencies in all comparisons made (p<0.05).

In Table 6, when the histopathological results of tissue examinations between Group 3 and Group 4 groups were compared in pairwise statistical analysis, no statistically significant difference was found between the groups in terms of treatment methods. Upon examination of Table 7, when pairwise statistical analysis of histopathological results of tissue examinations between Group 4 and Group 5 were conducted, it was observed that in Group 5 herbal capsule compound control, the presence of chronic inflammation/lymphoid follicles and gastritis-gastric ulcer was 80%, while it was not observed in Group 4, and this difference was found to be statistically significant (p=0.048). Additionally, a statistically significant difference was observed between the groups in terms of the presence of *H. pylori* (p=0.048). Histopathological examinations showing responses of different groups to gastritis treatment are depicted in the images (Figures 2-8).

Table 5. Statistical analysis of histopathological results in tissue examinations among groups

Variables	Group 1 sham group	Group 2 80% ethanol (C2H5OH)	Group 3 80% ethanol (C2H5OH) + *Momordica charantia*	Group 4 80% ethanol (C2H5OH) + PPI	Group 5 80% ethanol (C2H5OH) + herbal capsule compound	P[b] value
Edema						
Present	0	4 (80%)	1 (20%)	0	4 (80%)	**0.005**
Absent	5 (100%)	1 (20%)	4 (80%)	5 (100%)	1 (20%)	
Chronic inflammation lymphoid follicle						
Present	0	5 (100%)	1 (20%)	0	4 (80%)	**<0.001**
Absent	5 (100%)	0	4 (80%)	5 (100%)	1 (20%)	
Gastritis and gastric ulcer						
Present	0	5 (100%)	1 (20%)	0	4 (80%)	**<0.001**
Absent	5 (100%)	0	4 (80%)	5 (100%)	1 (20%)	
Prevalence of gastritis						
1-10%	0	2 (40%)	1 (20%)	1 (20%)	2 (40%)	**0.009**
11-20%	0	3 (60%)	0	0	2 (40%)	
None	5 (100%)	0	4 (80%)	4 (80%)	1 (20%)	
Erosion and ischemic necrosis						
Present	0	5 (100%)	1 (20%)	0	3 (60%)	**0.002**
Absent	5 (100%)	0	4 (80%)	5 (100%)	2 (40%)	
Activity of gastritis						
Present	0	5 (100%)	1 (20%)	0	3 (60%)	**0.002**
Absent	5 (100%)	0	4 (80%)	5 (100%)	2 (40%)	
Gastric bleeding						
Present	0	5 (100%)	1 (20%)	0	3 (60%)	**0.002**
Absent	5 (100%)	0	4 (80%)	5 (100%)	2 (40%)	
Intestinal metaplasia						
Present	0	4 (80%)	5 (100%)	4 (80%)	5 (100%)	
Absent	5 (100%)	1 (20%)	0	1 (20%)	0	**0.002**
Helicobacter pylori						
Present	4 (80%)	1 (20%)	1 (20%)	0	4 (80%)	
Absent	1 (20%)	4 (80%)	4 (80%)	5 (100%)	1 (20%)	**0.020**

The significance level was set at p<0.05
Variables were defined using n (%)
[b]: Fisher-Freeman-Halton test

Table 6. Pairwise statistical analysis of histopathological results of tissue examinations between Group 3 *Momordica charantia* and Group 4 PPI groups

Variables	Group 3 80% ethanol (C2H5OH) + *M. charantia*	Group 4 80% ethanol (C2H5OH) + PPI	P[b] value
Edema			
Present	1 (20%)	0	0.500
Absent	4 (80%)	5 (100%)	
Chronic inflammation lymphoid follicle			
Present	1 (20%)	0	0.500
Absent	4 (80%)	5 (100%)	
Gastritis and gastric ulcer			
Present	1 (20%)	0	0.500
Absent	4 (80%)	5 (100%)	
Prevalence of gastritis			
1-10%	1 (20%)	1 (20%)	
11-20%	0	0	0.778
None	4 (80%)	4 (80%)	
Erosion and ischemic necrosis			
Present	1 (20%)	0	0.500
Absent	4 (80%)	5 (100%)	
Activity of gastritis			
Present	1 (20%)	0	0.500
Absent	4 (80%)	5 (100%)	
Gastric bleeding			
Present	1 (20%)	1 (20%)	0.778
Absent	4 (80%)	4 (80%)	
Intestinal metaplasia			
Present	5 (100%)	4 (80%)	0.500
Absent	0	1 (20%)	
Helicobacter pylori			
Present	1 (20%)	0	0.500
Absent	4 (80%)	5 (100%)	

The significance level was set at p<0.05
Variables were defined using n (%)
[b]: Fisher-Freeman-Halton test, PPI: Proton pump inhibitor

Table 7. Pairwise statistical analysis of histopathological results of tissue examinations between Group 4 proton pump inhibitor and Group 5 herbal capsule compound control

Variables	Group 4 80% ethanol (C2H5OH) + PPI	Group 5 80% ethanol (C2H5OH) + herbal capsule compound	P[b] value
Edema			
Present	0	4 (80%)	**0.048**
Absent	5 (100%)	1 (20%)	
Chronic inflammation lymphoid follicle			
Present	0	4 (80%)	**0.048**
Absent	5 (100%)	1 (20%)	
Gastritis and gastric ulcer			
Present	0	4 (80%)	**0.048**
Absent	5 (100%)	1 (20%)	
Prevalence of gastritis			
1-10%	1 (20%)	2 (40%)	
11-20%	0	2 (40%)	0.524
None	4 (80%)	1 (20%)	
Erosion and ischemic necrosis			
Present	0	3 (60%)	0.167
Absent	5 (100%)	2 (40%)	
Activity of gastritis			
Present	0	3 (60%)	0.167
Absent	5 (100%)	2 (40%)	
Gastric bleeding			
Present	1 (20%)	3 (60%)	0.286
Absent	4 (80%)	2 (40%)	
Intestinal metaplasia			
Present	4 (80%)	5 (100%)	0.500
Absent	1 (20%)	0	
Helicobacter pylori			
Present	0	4 (80%)	**0.048**
Absent	5 (100%)	1 (20%)	

The significance level was set at p<0.05
Variables were defined using n (%)
[b]: Fisher-Freeman-Halton test, PPI: Proton pump inhibitors

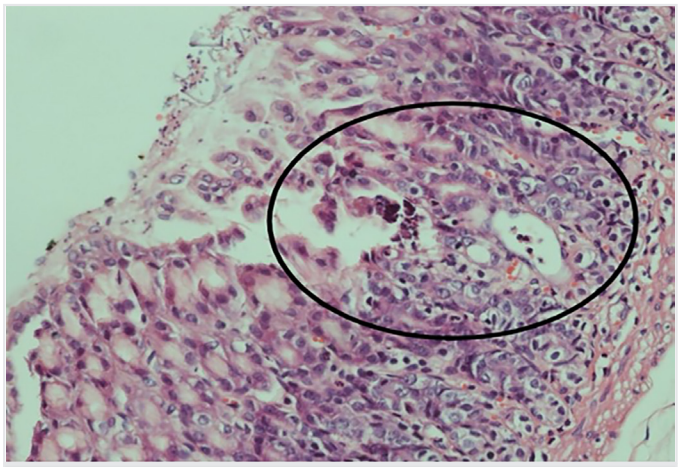

Figure 2. Mild active inflammation in gastric mucosa (H&E staining, 100x magnification)
H&E: Hematoxylin & eosin

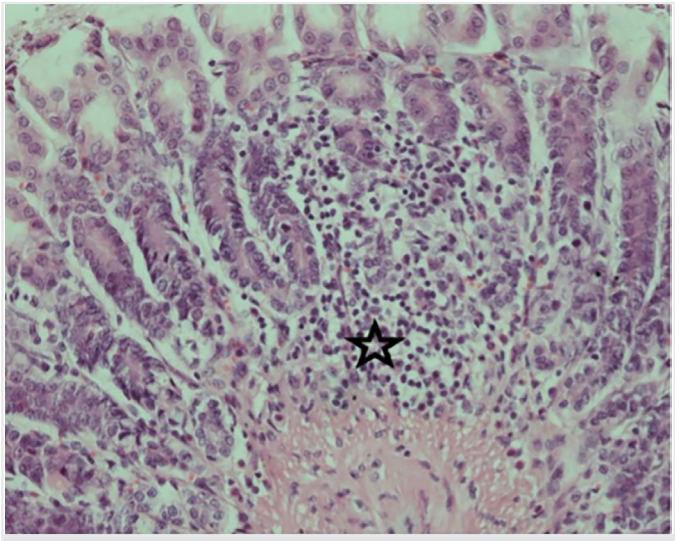

Figure 3. Chronic active inflammation in gastric mucosa (H&E staining, 100x magnification)
H&E: Hematoxylin & eosin

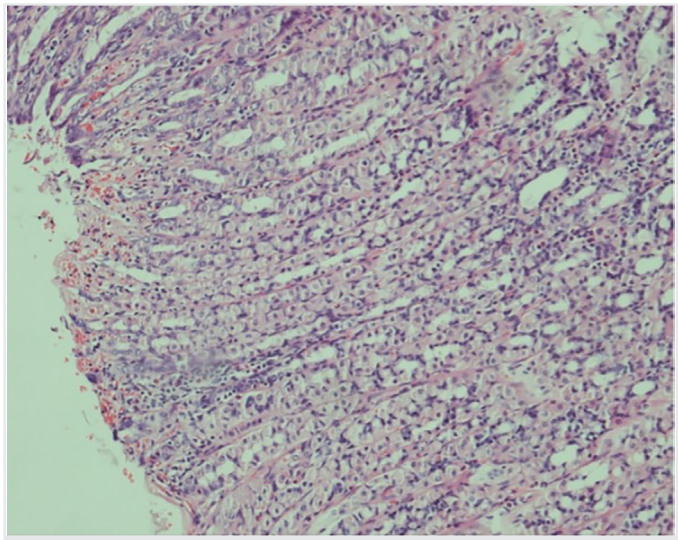

Figure 4. Chronic active inflammation and focal erosion in gastric mucosa (H&E staining, 100x magnification)
H&E: Hematoxylin & eosin

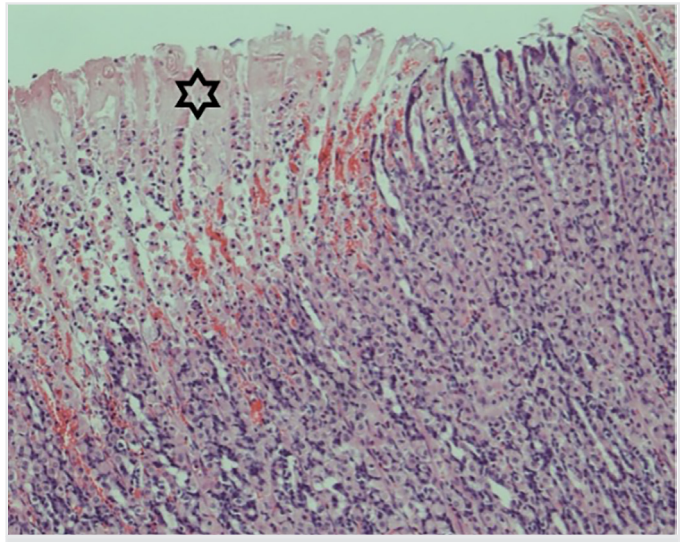

Figure 5. Erosion and infarction in gastric mucosa (H&E staining, 100x magnification)
H&E: Hematoxylin & eosin

Discussion

Gastritis ranks among the lifelong diseases, and it is estimated that half of the world's population will encounter or has encountered a condition related to gastritis throughout their lives. Looking at the long-term outcomes, it poses significant economic burdens on the healthcare systems of countries and is associated with progressive complications if left untreated (gastric ulcer, gastric perforation, iron deficiency anemia, chronic atrophic gastritis, gastric metaplasia-dysplasia/cancer, mucosa-associated lymphoid tissue lymphoma, neuroendocrine tumors, etc.) Early diagnosis, treatment, and management are crucial, and ongoing research by scientists in this field explores alternative treatments alongside existing standard therapies (2). Gastritis pathophysiology fundamentally involves the development of cell damage because of the release of free oxygen radicals by various mechanisms and mediators, initiated by an aggressive factor attacking the gastric mucosa. For instance, in *H. pylori*-associated gastritis, this damage occurs through different mechanisms mediated by various virulence factors (cell adhesion - BabA-sabA-OipA, urease A/B) (16). NSAIDs have been emphasized to trigger gastritis through the inhibition of prostaglandin synthesis (prostaglandins play a protective role in the gastric mucosa against damage caused by hydrochloric acid). In a study conducted by deFoneska et al. (17), similar mechanisms were highlighted in accordance with guideline recommendations.

The gastric mucosa damaged by the generated free oxygen radicals further exacerbates the damage to the mucosa through

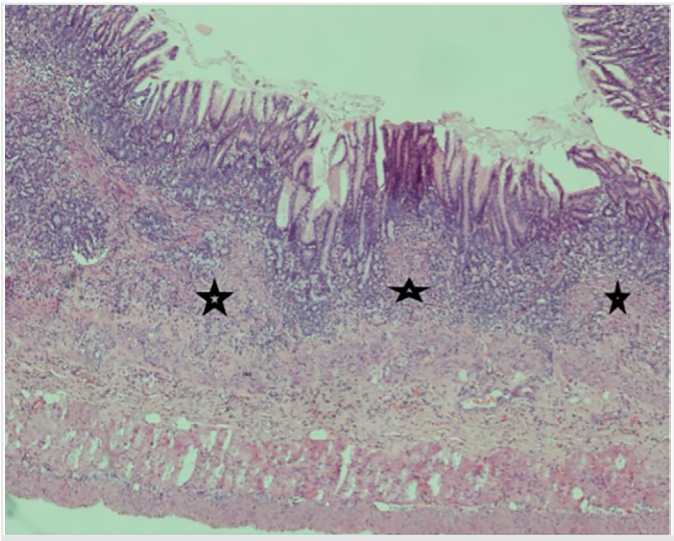

Figure 6. Chronic inflammation and atrophy in gastric mucosa (H&E staining, 40x magnification)

H&E: Hematoxylin & eosin

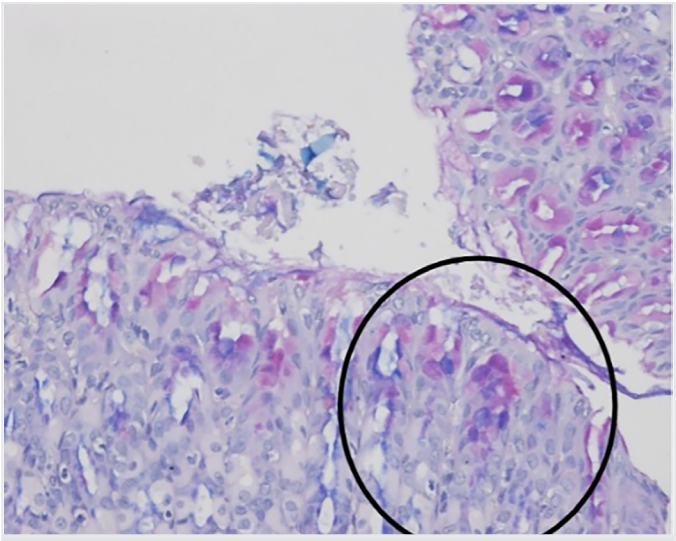

Figure 7. Positivity for intestinal metaplasia in gastric epithelium showing PAS-AB histochemistry (PAS-AB staining, 200x magnification)

PAS: Periodic acid-Schiff, AB: Alcian blue

lipid peroxidation and covalent binding, triggering the activation of antioxidant barriers in the body by the cells' perception. It is believed that determining total oxidative stress and total antioxidant levels biochemically and histopathologically may be beneficial in assessing the degree of damage and inflammation, aiding in current inflammation treatment. Total antioxidant levels are crucial for preventing advanced damage and can lead to a better understanding of homeostatic mechanisms. In previous studies, it has been reported that in cases where total antioxidant capacity decreases or reactive oxygen radicals cannot be neutralized, irreversible damage may occur in the cell nucleus (18).

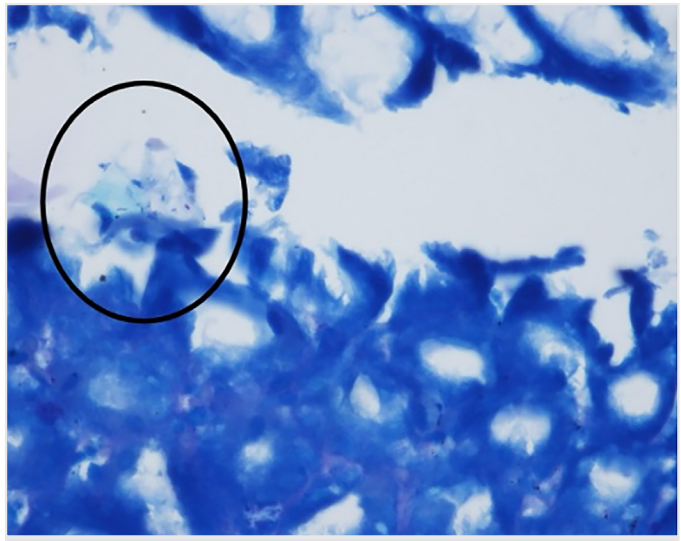

Figure 8. Spiral-shaped suspicious bacteria suggestive of *Helicobacter pylori* in giemsa histochemistry

In a study conducted by Jia et al. (8) in 2017, it was reported that extracts derived from *M. Charantia* could form a gel structure with pectin polysaccharides, exhibiting mucoprotective effects, and acting as potent anti-gastritis and anti-ulcerogenic agents. Similarly, Raish et al. (19) reported in their study that *M.charantia* inhibited inflammatory cytokines (such as TNF-α and IL-6) in isoproterenol-induced myocardial cells apoptosis. This effect was emphasized to occur through a decrease in intracellular free oxygen radicals level, restoration of endogenous antioxidant enzymes, and reduction in the formation of pro-apoptotic proteins. Furthermore, in another study, it was observed that treatment with *M. charantia* in mice led to a significant reduction in ethanol-induced TNF-α levels, thereby alleviating inflammation in the stomach. The reduction in gastric mucosal inflammation, characterized by a decrease in mucosal damage, edema, and leukocyte infiltration, was histopathologically demonstrated and supported by the presence of visibly reduced inflammatory cell infiltration and edema (11). Considering these effects, *M. Charantia* is thought to be effective in the treatment of gastritis.

In our study, to enhance the reliability of acute inflammatory parameter analyses, investigations were conducted in both blood and tissue samples among the groups. Significant differences were found in total oxidative stress and total antioxidant levels, oxidative stress index, IL-1β, IL-6, TNF α, TGF-β values. The median values of stress and inflammation parameters were observed to be highest in Group 2, as expected. Similarly, histopathological examinations revealed findings indicative of gastritis inflammation in Group 2, confirming the significance of the model.

As mentioned above, when examining the median values of biochemical parameters indicating acute inflammatory findings in Group 2, it was observed that they were higher in Group 3. When evaluated together with histopathological examinations,

the presence of edema, chronic inflammation/lymphoid follicles, gastritis, gastritis prevalence, erosion/ischemic necrosis, bleeding was not observed in most of Group 3. Therefore, it can be concluded that the administered *M. charantia* treatment is effective.

When comparing the results of histopathological tissue examinations among the groups, a statistically significant difference was found among all groups. In Group 1 and Group 4, no edema, chronic inflammation/lymphoid follicle presence, gastritis, gastritis prevalence, erosion, ischemic necrosis, and gastritis activity were observed. In advanced pairwise analyses, no significant difference was found between Group 3 and Group 4 groups in terms of gastritis treatment superiority. When evaluating the histopathological treatment responses of both groups, it is observed that both treatment alternative is effective.

Group 4 and Group 5 herbal capsule compound groups, a statistically significant difference was found in the parameters of edema presence, chronic inflammation / lymphoid follicle, and gastritis severity. It is observed that Group 4 is superior in these aspects. When examining the acute inflammatory biochemical parameters for Group 3, it was observed that the median values of total oxidative stress and oxidative stress index, IL-1β, IL-6, TNF α, and TGF-β were lower in the Group 5 while the median value of total antioxidant level in Group 3 was higher than that of the Group 5 control. Based on this, it could be said that Group 5 control was more effective in gastritis treatment when examined in histopathological data. Among all groups, the lowest acute inflammatory parameter median values were found in the gold standard Group 4. Histopathologically, when intestinal metaplasia was evaluated, the most effective treatment method appeared to be Group 4. It seemed that the mucoprotective effect of Group 3 was insufficient here, and similarly, Group 5 also failed to prevent intestinal metaplasia. This situation may be related to the different mechanisms of action they use in their treatment efficacy.

H. pylori can exhibit a spectrum of effects ranging from mild gastritis to cancer; therefore, it should be considered in cases of gastritis resistant to medical treatment. In our study group, *H. pylori* was not detected in Group 4, but it was found in 20% of Group 3. In Group 5, *H. pylori* presence was observed in a significant portion (80%). After determining the etiology of gastritis, eradication treatment for *H. pylori* should be added in addition to the current treatment. In addition to the existing *H. pylori* eradication therapy, *M. charantia* may be effective through mucoprotective and antioxidant mechanisms.

Study Limitations

This study has several limitations. The relatively small sample size and the use of an ethanol-induced rat gastritis model may limit the generalizability of the findings to human clinical settings. Moreover, while the study provides detailed biochemical and histopathological data, it does not address long-term treatment outcomes or potential side effects. Finally, the effects of the tested compounds were evaluated only in acute gastritis; further studies are needed to explore their efficacy in chronic gastritis and in combination with standard therapies such as *H. pylori* eradication.

Conclusion

This study demonstrated that *M. charantia* reduced mucosal damage in gastritis, mainly by strengthening mucoprotective defenses and by suppressing inflammation and oxidative stress through its antioxidant effects. To our knowledge, the effects of appropriately formulated *M. charantia* on gastritis have not been previously investigated in detail, highlighting the novelty of our findings. Phytotherapeutic agents specifically selected for the disease may exert synergistic effects alone or with conventional therapies, offering fewer side effects and lower recurrence rates. Such treatments could serve as adjuncts or alternatives to proton pump inhibitors in managing or preventing gastritis and gastric ulcers and may be considered alongside eradication therapy in *H. pylori* infections. These results lay the groundwork for future research and suggest that *M. charantia* may represent a promising natural therapeutic option.

Ethics

Ethics Committee Approval: Ethical approval for animal experimentation was obtained from the Local Ethics Committee for Animal Experiments for the Gastritis Model Animal Experimental Study at Bezmialem Vakıf University (decision no: 2022/06, date: 24.01.2022).

Informed Consent: This study involved experimental animals only.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: Y.İ., A.A., N.Ş., E.M.G., Concept: Y.İ., A.A., C.G., Design: Y.İ., A.A., Data Collection or Processing: Y.İ., A.A., C.G., N.Ş., E.M.G., Analysis or Interpretation: Y.İ., A.A., C.G., N.Ş., E.M.G., Literature Search: Y.İ., A.A., C.G., E.M.G., Writing: Y.İ., C.G., E.M.G.

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Original Article

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Evaluation of Educational Quality and Reliability of Laparoscopic Liver Hydatid Cyst Surgery Videos on YouTube

YouTube'da Yayınlanan Laparoskopik Karaciğer Kist Hidatik Cerrahisi Videolarının Eğitsel Kalitesi ve Güvenilirliğinin Değerlendirilmesi

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ABSTRACT

Objective: This study aims to evaluate the educational quality and reliability of YouTube videos on laparoscopic hydatid cyst surgery (LHCS), focusing on various factors such as narration, subtitles, and user engagement metrics.

Methods: A cross-sectional analysis was conducted on 34 YouTube videos related to LHCS. Videos were assessed using Laparoscopic Surgery Video Educational Guideline (LAP-VEGaS), Journal of the American Medical Association (JAMA), and Global Quality Score (GQS). Parameters including video duration, presence of spoken commentary, subtitles, number of likes, total views, and average daily views were recorded. Statistical analyses, including descriptive statistics, correlation assessments, and linear regression models, were utilized to evaluate the impact of these factors on the educational quality scores.

Results: Videos with spoken commentary scored significantly higher across LAP-VEGaS, JAMA, and GQS. Subtitled videos showed a borderline significant increase in GQS but not in other metrics. Significant positive correlations were found between LAP-VEGaS scores and JAMA scores, GQS, annual likes, total views, and daily average views. Univariate regression analysis identified video duration and presence of spoken commentary as significant predictors for LAP-VEGaS scores. In multivariate regression, spoken commentary and upload time were significant variables influencing LAP-VEGaS and JAMA scores.

Conclusion: The presence of spoken commentary significantly enhances the educational value of LHCS videos on YouTube. While subtitles provide additional support, they are not as

ÖZ

Amaç: Bu çalışma, laparoskopik kist hidatik cerrahisi (LKHC) ile ilgili YouTube videolarının eğitsel kalitesini ve güvenilirliğini değerlendirmeyi amaçlamakta; anlatım, altyazı ve kullanıcı etkileşim metrikleri gibi çeşitli faktörler üzerine odaklanmaktadır.

Yöntemler: YouTube'da LKHC ile ilgili 34 video üzerinde kesitsel bir analiz gerçekleştirilmiştir. Videolar; Laparoskopik Cerrahi Video Eğitim Rehberi (LAP-VEGaS), Amerikan Tabipler Birliği Dergisi (JAMA) ve Küresel Kalite Skoru (GQS) kullanılarak değerlendirilmiştir. Video süresi, sesli anlatımın varlığı, altyazı kullanımı, beğeni sayısı, toplam izlenme sayısı ve günlük ortalama izlenme sayısı gibi parametreler kaydedilmiştir. Bu faktörlerin eğitsel kalite puanları üzerindeki etkisini değerlendirmek amacıyla tanımlayıcı istatistikler, korelasyon analizleri ve doğrusal regresyon modelleri uygulanmıştır.

Bulgular: Sesli anlatım içeren videolar, LAP-VEGaS, JAMA ve GQS puanlarında anlamlı şekilde daha yüksek skorlar elde etmiştir. Altyazılı videolar, yalnızca GQS puanında sınıra yakın anlamlı bir artış göstermiştir; diğer metriklerde ise anlamlı bir fark saptanmamıştır. LAP-VEGaS puanları ile JAMA puanları, GQS, yıllık beğeni sayısı, toplam izlenme ve günlük ortalama izlenme sayısı arasında anlamlı pozitif korelasyonlar bulunmuştur. Tek değişkenli regresyon analizinde, video süresi ve sesli anlatımın varlığı LAP-VEGaS skorları için anlamlı yordayıcılar olarak belirlenmiştir. Çok değişkenli regresyon analizinde ise sesli anlatım ve videonun yüklenme zamanı, LAP-VEGaS ve JAMA puanlarını etkileyen anlamlı değişkenler olarak öne çıkmıştır.

Sonuç: Sesli anlatımın varlığı, YouTube'daki LKHC videolarının eğitsel değerini önemli ölçüde artırmaktadır. Altyazılar ise ek

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impactful as spoken commentary. Regular updates and professional production are crucial to maintain the relevance and accuracy of these educational resources.

Keywords: Educational videos, hydatid cyst, laparoscopic surgery, medical education, YouTube

destek sağlasa da, sesli anlatım kadar etkili değildir. Bu tür eğitim kaynaklarının güncelliğini ve doğruluğunu koruyabilmesi için düzenli güncellemeler ve profesyonel yapım kalitesi büyük önem taşımaktadır.

Anahtar Kelimeler: Eğitsel videolar, kist hidatik, laparoskopik cerrahi, tıp eğitimi, YouTube

Introduction

Hydatid cyst (HC) is a zoonotic disease that spreads throughout our country, particularly in our region. The most prevalent cause is *Echinococcus granulosus*. In humans, 70% accumulate in the liver, 20% in the lungs, and 10% in other organs (1,2).

Although previously treated with laparotomy and total or partial precystectomy, HC surgery, like many other surgical procedures, is now being performed via laparoscopy. One of the most significant drawbacks of laparoscopic procedures for surgeons is the lengthy training period. Because the learning curve in laparoscopic surgery is longer than in open surgery, surgeons are increasingly using alternative training models, particularly for laparoscopic surgery. To accomplish this, they try to learn about the surgical procedure and shorten their learning time by watching surgical videos online (3).

YouTube is a platform that houses a massive video-sharing network. Today, this platform assists many surgeons in their training. However, because the published videos are not subject to supervision, it is unclear whether they are educationally valuable or an adequate educational resource. In particular, the presence of disparate information and applications in other videos about the same surgical procedures published on these platforms makes it difficult to locate the appropriate information and applications. Several scoring systems have been developed to demonstrate the quality and reliability of educational video content.

Educators from 26 international institutions created the Laparoscopic Surgery Video Educational Guideline (LAP-VEGaS) to standardize the quality of online educational videos on laparoscopic procedures (3). The Journal of the American Medical Association (JAMA) and Global Quality Score (GQS) scoring systems evaluate video reliability and content. Silberg et al. (4) designed the JAMA scoring system to assess the transparency of video sources and published data. It is used to identify untrustworthy videos of unknown origin. Bernard defines the GQS as a scoring system that categorizes videos based on their content (5).

Although there are several laparoscopic HC surgery (LHCS) videos on YouTube, no research has been conducted to evaluate the quality of these videos in terms of their contribution to surgical education. In this regard, our study is the first of its kind.

The purpose of this study was to evaluate the educational quality and reliability of LHCS videos on YouTube using the LAP-VEGaS, the JAMA scoring system, and the GQS system.

Methods

Study Design

We performed research on YouTube without making any changes in the normal search preferences and after selecting the "sort by relevance" option, using the keywords LHC and LHCS on December 15, 2023. Because YouTube is a public platform and no personal information is used, no ethics committee approval is required for the study (6). A total of 45 videos with at least 1,000 views were identified.

Inclusion and Exclusion Criteria

Exclusion criteria for the obtained videos included videos in which total cyst excision was performed, videos in which the entire procedure was not published, the presence of an accompanying surgical procedure, videos containing LHCS performed outside the liver, and repetitive videos. Only videos featuring English verbal narration or subtitles were included in the study. Furthermore, it was assumed that the educational value of published videos with a duration of less than 4 min would be insufficient, and videos with fewer than 1,000 views were excluded from the study because they were not popular among surgeons. The study included 34 videos in total, with the remaining cases being published that were liver-related and underwent laparoscopic surgery. All videos included in the study were liver-related LHCS predominantly demonstrating laparoscopic (partial) cystectomy/pericystectomy techniques. Of these, 8 were uploaded by academic sources (university-affiliated channels or conference presentations), while 26 were shared via individual physician accounts.

Data Collection and Assessment of Quality and Reliability of Videos

The number of likes, dislikes, verbal or subtitled narration, video duration, time since the video upload date, the daily number of views, and the total number of views were recorded. Videos were evaluated using the LAP-VEGaS, as well as JAMA and GQS scores. LAP-VEGaS was created by educators from 26 international institutions as a video evaluation tool to standardize the quality of online educational videos about laparoscopic procedures (3). It enables video evaluation using nine parameters (Table 1). Each parameter is awarded 0 points if it is not presented in the video, 1 point if it is partially presented, and 2 points if it is fully presented. The total score ranges from 0 to 18. Videos with scores of 0 to 6 are of poor educational quality, those with scores of 7 to 12 are of medium quality, and those with scores of 12 or higher are of good quality. Silberg et al. (4) defined the JAMA scoring system to assess the video source's

Table 1. Laparoscopic surgery video educational guideline

1. Author and institution information
2. Formal case presentation
3. Patient position and access
4. Step-by-step procedure walkthrough
5. Intraoperative findings demonstrated
6. Operating time and other important outcomes
7. Additional graphic aids
8. Audio or written commentary in English
9. Good image quality and video speed

transparency and publication information. It is used to detect untrustworthy videos with unknown origins. It has four criteria, each worth 1 point (Table 2). According to the scoring system, videos with 1 point are considered inadequate, videos with 2 to 3 points are considered partially adequate, and videos with 4 points are considered entirely adequate. Bernard defines GQS as a scoring system that defines videos based on their content (5). This scoring system assigns video scores ranging from 1 to 5 (Table 2). Videos were considered low quality (1 or 2), medium quality (3), or high-quality (4 or 5).

Before the videos were evaluated, three general surgeons (M.S.B., H.Y., H.E.) with experience in LHCS in our clinic discussed the evaluation criteria for LAP-VEGaS, JAMA, and GQS scores and developed a common standard. Then, two general surgeons scored the videos according to the guide, unaware of each other. In the videos, if there was a difference in scoring, a third surgeon's opinion was sought.

Statistical Analysis

Statistical analyses were carried out with the Jamovi software package (version 2.3.28, The Jamovi project, 2023) and the Jeffreys's Amazing Statistics Program software package (version 0.18.3, 2024). Descriptive statistics were used to summarize the study's results. Results for continuous numerical variables were presented as mean ± standard deviation or median, minimum, and maximum based on distribution. Categorical variables were summarized using numbers and percentages. The normality of numerical variables was assessed using appropriate tests and visual tools, taking into account the sample size and data characteristics. When comparing small samples (n<50), the Shapiro-Wilk test was preferred. In addition, visual tools such as histograms and quantile-quantile plots were used to assess the assumption of normality. To compare differences in categorical variables across groups, the Pearson chi-square test was used for 2×2 tables with expected cell counts of 5 or more, as larger sample sizes provide more accurate results. For 2×2 tables with expected cell counts of less than 5, the Fisher's exact test was preferred due to its higher precision with small sample sizes. In R×C tables with expected cell counts less than 5, the Fisher-Freeman-Halton test was used because it is appropriate for small samples. When numerical variables did not have a normal distribution and were compared between two independent groups, the Mann-Whitney U test was preferred. Spearman's ρ correlation coefficient was used to assess the relationship between numerical variables that did not follow a normal distribution. In this study, univariate and multivariate linear regression analyses were used to identify factors that predict LAP-VEGaS score, JAMA Score, and GQS in LHCS videos. In univariate analyses, the impact of independent variables such as annual likes, video duration, average daily views, time since upload, presence of spoken commentary, and presence of subtitles on LAP-VEGaS score, JAMA Score, and GQS was assessed separately. β coefficients, 95% confidence intervals, and p-values were computed for each independent variable. In multivariate linear regression analyses, the combined effects of these variables were assessed while controlling for the impact of other factors, with β coefficients, 95% confidence intervals, and p-values provided for each variable. A p-value of <0.05 indicated statistical significance.

Results

This study included 34 videos about LHCS. The median time since the videos' initial publication was 7.2 years. The median number of likes was 18.5, and the average number of likes per year was 2.4. The videos had a median duration of 8.4 min. The median total number of views was 2,400, with a median daily

Table 2. JAMA and Global Quality Scoring system

Journal of the American Medical Association Score	
Authorship	Authors and contributors, their affiliations, and relevant credentials should be provided
Attribution	References and sources for all content should be listed clearly, and all relevant copyright information should be noted
Disclosure	Website "ownership" should be prominently and fully disclosed, as should any sponsorship, advertising, underwriting, commercial funding arrangements or support, or potential conflicts of interest
Currency	Dates when content was posted and updated should be indicated
Global Quality Score	
1)	Poor quality, very unlikely to be of any use to patients
2)	Poor quality but some information present, of very limited use to patients
3)	Suboptimal flow, some information covered but important topics missing, somewhat useful to patients
4)	Good quality and flow, most important topics covered, useful to patients
5)	Excellent quality and flow, highly useful to patients

JAMA: Journal of the American Medical Association

view count of 1. The median LAP-VEGaS score was 5.5, the JAMA score was 2, and the GQS was 3 (Table 3).

Videos with narration received significantly more likes (p=0.045), longer video durations (p=0.017), higher average daily views (p=0.042), higher LAP-VEGaS scores (p<0.001), higher JAMA scores (p<0.001), and higher GQS (p<0.001). Videos with spoken narration were significantly more likely to score 4 points in JAMA and 5 points in GQS (Table 3).

There was no significant difference between videos with and without narration in terms of total time on air, liking status, annual likes, total number of views, and subtitles presence (p>0.05). The GQS was marginally higher in subtitled videos (p=0.054). The LAP-VEGaS score was also higher in subtitled videos, although the difference was not statistically significant (p=0.076). Other variables such as the total time the video was on air, like status, number of likes, annual average of likes, video duration, total number of views, daily average number of views, JAMA score, JAMA score distribution, and presence of voiceover showed no significant difference between the groups (p>0.05, Table 4).

When evaluating videos on LHCS, the LAP-VEGaS score was correlated with the JAMA score (r=0.737, p<0.001), GQS (r=0.896, p<0.001), average annual rating (r=0.560, p<0.001), total number of views (r=0.423, p=0.013), and average daily number of views. The JAMA score and GQS (r=0.802, p<0.001), annual average rating (r=0.568, p<0.001), total number of views (r=0.533, p=0.001), and daily average number of views (r=0.539, p<0.001) showed significant and positive correlations. GQS also showed significant positive correlations with annual average number of likes (r=0.523, p=0.002), total number of views (r=0.391, p=0.022), and daily average number of views (r=0.500, p=0.003). However, there was a weak to moderate negative correlation found between GQS scores and the total time the video was on air (r=-0.343, p=0.047). A positive correlation was found between the annual average number of likes, the daily average number of views, and the total number of views (r=0.803, p<0.001 and r=0.514, p=0.003); however, a strong negative correlation was found with the total time the video was on air (r=-0.710, p<0.001). There was a strong and positive correlation between total views and average daily views (r=0.844, p<0.001) and a moderate negative correlation between

Table 3. Performance comparison of content with and without voiceover in social media videos on laparoscopic hydatid cyst surgery: likes, views and quality analysis

	Overall (n=34)	Spoken commentary		p-value
		Absent (n=26)	Present (n=8)	
Time since upload (years)§	7.2 (2.9 - 14.2)	7.7 (3.6 - 12.0)	5.9 (2.9 - 14.2)	0.591*
Like status, yes‡	32 (94.1)	24 (92.3)	8 (100.0)	0.999**
Number of likes§	18.5 (1.0 - 724.0)	13.5 (1.0 - 724.0)	44.0 (12.0 - 193.0)	0.045*
Annual likes (average per year)§	2.4 (0.1 - 96.1)	1.6 (0.1 - 96.1)	13.1 (1.0 - 38.9)	0.078*
Number of dislikes§	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	N/A
Video duration (minutes)§	8.4 (4.0 - 43.5)	7.4 (4.0 - 29.3)	14.8 (7.0 - 43.5)	0.017*
Total view count§	2.4 (1.0 - 140.1)	1.9 (1.0 - 140.1)	6.5 (1.3 - 23.2)	0.065*
Average daily views§	1.0 (0.2 - 50.8)	0.9 (0.2 - 50.8)	3.9 (0.9 - 6.6)	0.042*
LAP-VEGaS score§	5.5 (0.0 - 16.0)	4.0 (0.0 - 10.0)	13.0 (7.0 - 16.0)	<0.001*
JAMA score§	2.0 (1.0 - 4.0)	2.0 (1.0 - 3.0)	4.0 (3.0 - 4.0)	<0.001*
JAMA score‡				
1	8 (23.5)	8 (30.8)	0 (0.0)	<0.001**
2	13 (38.2)	13 (50.0)	0 (0.0)	
3	7 (20.6)	5 (19.2)	2 (25.0)	
4	6 (17.6)	0 (0.0)	6 (75.0)	
GQS§	3.0 (1.0 - 5.0)	3.0 (1.0 - 5.0)	5.0 (4.0 - 5.0)	<0.001*
GQS‡				
1	3 (8.8)	3 (11.5)	0 (0.0)	<0.001**
2	3 (8.8)	3 (11.5)	0 (0.0)	
3	12 (35.3)	12 (46.2)	0 (0.0)	
4	9 (26.5)	7 (26.9)	2 (25.0)	
5	7 (20.6)	1 (3.8)	6 (75.0)	
Subtitles, present‡	7 (20.6)	5 (19.2)	2 (25.0)	0.999**

‡: n (%), §: Median (minimum-maximum), *: Mann-Whitney U test, **: Pearson chi-square, Fisher's exact, Fisher-Freeman-Halton test, p bold statistically significant, LAP-VEGaS: Laparoscopic Surgery Video Educational Guideline, JAMA: Journal of the American Medical Association, GQS: Global Quality Score, N/A: Not available

Table 4. Comparison of video metrics based on the presence of subtitles in videos about laparoscopic hydatid cyst surgery

	Subtitles		p-value
	Absent (n=27)	Present (n=7)	
Time since upload (years)§	7.8 (2.9 - 14.2)	5.0 (3.6 - 12.4)	0.335*
Like status, yes‡	26 (96.3)	6 (85.7)	0.374**
Number of likes§	18.5 (1.0 - 724.0)	26.5 (12.0 - 76.0)	0.439*
Annual likes (average per year)§	2.0 (0.1 - 96.1)	5.1 (1.0 - 19.2)	0.408*
Number of dislikes§	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	N/A
Video duration (minutes)§	9.1 (4.5 - 43.5)	7.4 (4.0 - 12.1)	0.403*
Total view count§	2.2 (1.0 - 140.1)	4.4 (1.4 - 23.2)	0.297*
Average daily views§	0.9 (0.2 - 50.8)	2.7 (0.7 - 5.7)	0.249*
LAP-VEGaS score§	5.0 (0.0 - 16.0)	9.0 (3.0 - 15.0)	0.076*
JAMA score§	2.0 (1.0 - 4.0)	3.0 (2.0 - 4.0)	0.205*
JAMA score‡			
1	8 (29.6)	0 (0.0)	0.219**
2	10 (37.0)	3 (42.9)	
3	4 (14.8)	3 (42.9)	
4	5 (18.5)	1 (14.3)	
GQS§	3.0 (1.0 - 5.0)	4.0 (3.0 - 5.0)	0.054*
GQS‡			
1	3 (11.1)	0 (0.0)	0.265**
2	3 (11.1)	0 (0.0)	
3	11 (40.7)	1 (14.3)	
4	5 (18.5)	4 (57.1)	
5	5 (18.5)	2 (28.6)	
Spoken commentary, present‡	6 (22.2)	2 (28.6)	0.999**

‡: n (%), §: Median (minimum-maximum), *: Mann-Whitney U test, **. Pearson chi-square, Fisher's exact, Fisher-Freeman-Halton test
LAP-VEGaS: Laparoscopic Surgery Video Educational Guideline, JAMA: Journal of the American Medical Association, GQS: Global Quality Score, N/A: Not available

total time on air and average daily views (r=-0.443, p=0.009). Other pairwise comparisons revealed no significant relationships (p>0.05, Figure 1).

The univariate analysis of the linear regression model for predicting the LAP-VEGaS score revealed that video duration (p=0.034) and speech commentary (p<0.001) were significant variables. A one-unit increase in video duration was correlated with a 0.16-unit increase in LAP-VEGaS scores. Videos with speech commentary, in contrast, showed a significantly higher increase in LAP-VEGaS scores, up 7.59 units. However, the annual average number of likes, daily average number of views, upload time, and presence of subtitles were found to be non-significant (p>0.05). Significant variables in the multivariate linear regression analysis included speech commentary (p<0.001) and upload time (p=0.015). As a result, a one-unit increase in the total time since the video's uploaded resulted in a 0.37 unit decrease in LAP-VEGaS scores, whereas LAP-VEGaS scores increased by 7.5 units in videos with speech commentary. Video duration was not found to be a significant predictor (p=0.966, Table 5).

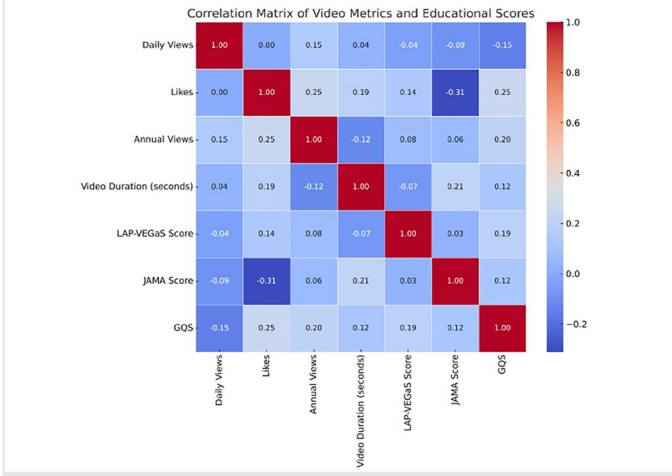

Figure 1. The correlation matrix heatmap illustrates the relationships between various video metrics and educational scores (Spearman's rho correlation coefficient was used)

GQS: Global Quality Score, JAMA: Journal of the American Medical Association, LAP-VEGaS: Laparoscopic Surgery Video Educational Guideline

The univariate analysis found that the average annual rating (p=0.044) and the presence of speech commentary p<0.001 were significant predictors of the JAMA score. A one-unit increase in the average annual rating resulted in a 0.02-unit increase in the JAMA score, whereas the JAMA score increased by 1.87 units in videos with speech commentary. The effects of video duration, average daily views, upload time, and subtitles presence were non-significant (p>0.05). Significant variables in the multivariate linear regression analysis included speech commentary (p<0.001) and average annual rating (p=0.003). As a result, a one-unit increase in the average annual rating resulted in a 0.01-unit increase in the JAMA score; however, in videos with speech commentary, the JAMA score increased by 1.91 units (Table 6).

Univariate analysis of the linear regression model for predicting GQS revealed that the presence of speech commentary was the only significant variable (p<0.001). GQS increased by 1.75 units in videos with speech commentary. The effects of annual average likes, video duration, daily average number of views, upload time, and subtitles presence were non-significant (p>0.05). Speech commentary was a significant variable in the multivariate linear regression analysis (p<0.001). GQS increased by 1.68 units in videos with speech commentary. The total duration of the video's broadcast was marginally significant (p=0.051). Therefore, every one-unit increase in the total duration of the video's broadcast resulted in a 0.1-point decrease in GQS scores. Conversely, the presence of subtitles was not found to be a significant predictor (p=0.071, Table 7).

The links of the videos included in the study are provided in Table 8.

Table 5. Linear regression analysis predicting "Laparoscopic Surgery Video Educational Guideline Score" in laparoscopic hydatid cyst surgery videos

	Univariate linear regression		Multivariate linear regression	
	Beta coefficient (CI 95%)	p-value	Beta coefficient (CI 95%)	p-value
Annual likes (average per year)	0.05 (-0.02 - 0.12)	0.167	-	-
Video duration (seconds)	0.16 (0.02 - 0.29)	0.034	0.01 (-0.10 - 0.09)	0.966
Average daily views	0.04 (-0.11 - 0.20)	0.590	-	-
Time since upload (years)	-0.41 (-0.86 - 0.04)	0.080	-0.37 (-0.65 - -0.09)	0.015
Spoken commentary: present vs. absent	7.59 (5.47 - 9.73)	<0.001	7.5 (5.27 - 9.73)	<0.001
Subtitles: present vs. absent	2.68 (-0.75 - 6.11)	0.135	-	-

CI: Confidence interval

Table 6. Linear regression analysis predicting "Journal of the American Medical Association Score" in laparoscopic hydatid cyst surgery videos

	Univariate linear regression		Multivariate linear regression	
	Beta coefficient (CI 95%)	p-value	Beta coefficient (CI 95%)	p-value
Annual likes (average per year)	0.02 (0.01 - 0.03)	0.044	0.01 (0.01 - 0.02)	0.003
Video duration (seconds)	0.03 (0.01 - 0.07)	0.102	-	-
Average daily views	0.03 (-0.01 - 0.06)	0.181	-	-
Time since upload (years)	-0.08 (-0.19 - 0.03)	0.151	-	-
Spoken commentary: present vs. absent	1.87 (1.34 - 2.39)	<0.001	1.91 (1.48 - 2.34)	<0.001
Subtitles: present vs. absent	0.49 (-0.37 - 1.35)	0.269		

CI: Confidence interval

Table 7. Linear regression analysis predicting "Global Quality Score" in laparoscopic hydatid cyst surgery videos

	Univariate linear regression		Multivariate linear regression	
	Beta coefficient (CI 95%)	p-value	Beta coefficient (CI 95%)	p-value
Annual likes (average per year)	0.01 (-0.01 - 0.03)	0.316	-	-
Video duration (seconds)	0.02 (-0.02 - 0.06)	0.383	-	-
Average daily views	0.01 (-0.04 - 0.05)	0.753	-	-
Time since upload (years)	-0.13 (-0.25 - 0.01)	0.059	-0.1 (-0.19 - 0.01)	0.051
Spoken commentary: present vs. absent	1.75 (1.02 - 2.48)	<0.001	1.68 (1.02 - 2.34)	<0.001
Subtitles: present vs. absent	0.92 (-0.03 - 1.87)	0.066	0.67 (-0.03 - 1.38)	0.072

CI: Confidence interval

Table 8. The links of the videos included in the study

Youtube hydatid cyst video links
https://www.youtube.com/watch?v=a7tbnKx5Hx4
https://www.youtube.com/watch?v=lizYNwMKKkI
https://www.youtube.com/watch?v=Hdwd017TyvE
https://www.youtube.com/watch?v=wTiNBVLZjDE
https://www.youtube.com/watch?v=s5wAMLV2DFg
https://www.youtube.com/watch?v=NHg2OE0WLTs
https://www.youtube.com/watch?v=B46gsuhSuYk
https://www.youtube.com/watch?v=nP6DmzNJSSM
https://www.youtube.com/watch?v=1hMgWUxAgPM
https://www.youtube.com/watch?v=Do9ADA-jKmM
https://www.youtube.com/watch?v=_UDlBiggWWs
https://www.youtube.com/watch?v=eT4kelKlMsk
https://www.youtube.com/watch?v=vSm17Nc5tJo
https://www.youtube.com/watch?v=DnxoVCFBUCo
https://www.youtube.com/watch?v=tufCCUnR0Ek
https://www.youtube.com/watch?v=k-uhdEGF3a8
https://www.youtube.com/watch?v=uUKJ_Eu1gjU
https://www.youtube.com/watch?v=E-rUhuxibXM
https://www.youtube.com/watch?v=qS2jaC0qBF8
https://www.youtube.com/watch?v=D0AgnqSOTGc
https://www.youtube.com/watch?v=ptJaXTDIRew
https://www.youtube.com/watch?v=7lbNoni3ay8
https://www.youtube.com/watch?v=TOLXk3Shgm8
https://www.youtube.com/watch?v=7KMASFct-Mo
https://www.youtube.com/watch?v=rOqNdhf530g
https://www.youtube.com/watch?v=6yfEVFbASB0
https://www.youtube.com/watch?v=GvEWKyxk9xg
https://www.youtube.com/watch?v=Yd5dBxbtnxU
https://www.youtube.com/watch?v=UpeZJIe4siE
https://www.youtube.com/watch?v=lz-QGd5V-3g
https://www.youtube.com/watch?v=Vg3Xx23CjiY
https://www.youtube.com/watch?v=A-9I36LCvb4
https://www.youtube.com/watch?v=SkjyBeJCe-E
https://www.youtube.com/watch?v=vts_YEsFeac

Discussion

Surgical education, like our lives, has changed as a result of technological advancements in recent years. The most significant development is that, in addition to traditional face-to-face surgical education, online education has begun to gain traction. Although many factors have been proposed to explain this shift, the most important factor in surgeons turning to online education appears to be the lengthy learning curve associated with laparoscopic surgery practices. Many surgeons want to accelerate their learning curve by watching online videos. For this reason, online training videos are becoming increasingly popular among surgeons seeking to improve their knowledge and skills, particularly in laparoscopic surgery (7-10).

At this point, publishing videos with accurate, up-to-date, and reliable information on online platforms is critical. Unfortunately, YouTube ranks its videos based on the number of views or comments rather than the quality of the content. This sorting is not appropriate for education. In a study emphasizing the significance of this situation, only one of the most 10 popular laparoscopic cholecystectomy videos was found to be appropriate for surgical training (11). However, studies have shown that information obtained from YouTube may be inaccurate or misleading. A review of this issue revealed that the majority of the videos contained incorrect, out-of-date information, resulting in false teachings (12).

Previous research has found varying levels of educational content on YouTube for various surgical procedures. For example, Wu et al. (13) assessed the educational quality of cholesteatoma surgery videos and identified significant areas for improvement, emphasizing the importance of high-quality educational content on public platforms such as YouTube. Similarly, Unal et al. (14) discovered low educational quality in laparoscopic hysterectomy videos, emphasizing the importance of peer-reviewed educational resources during the coronavirus disease 2019 era. Shapiro et al. (15) noted the low quality of endoscopic sinus surgery videos and advised against relying solely on them for surgical training. Tan et al. (16) found that laparoscopic distal pancreatectomy videos on YouTube lacked educational quality. Our current study also found significant gaps in the educational value of LHCS videos, particularly those that lack spoken commentary or professional production standards. Our study backs up these findings, demonstrating that the presence of spoken commentary significantly improves the educational value of surgical videos. In a study of laparoscopic cholecystectomy videos, the most commonly performed procedure, only 15.1% were found to be educationally sufficient. In the same study, it was found that the video duration, number of views, and likes did not correlate with video quality (17). In contrast, our study found that high-scoring videos were watched and liked significantly more, but there was no correlation with video duration. Chapman et al. (18) found that the LAP-VEGaS score was very low, on average 6, which is consistent with our findings.

Other studies have looked into the relationship between user engagement metrics (such as likes and views) and educational quality. Zhang et al. (19) assessed laparoscopic gastrectomy videos and found varying levels of information completeness and reliability, indicating similar challenges in user engagement and educational quality. In our study, we found significant positive correlations between LAP-VEGaS, JAMA scores, and user

engagement metrics, implying that higher engagement often leads to better educational content.

Videos with spoken commentary consistently performed better on educational metrics. This is supported by findings from studies on other surgical procedures, such as one by Balta et al. (20) who found that using videos in training could improve surgical opinion. The presence of subtitles resulted in a borderline significant increase in GQS but was less effective than spoken commentary. This finding suggests that, while subtitles can help you understand, they are not a substitute for detailed spoken explanations.

Study Limitations

This study has several limitations that must be addressed. To begin, the sample size of 34 videos may not fully represent the range of LHCS videos available on YouTube. The limited sample size may have impacted the generalizability of our findings. Future research with larger sample sizes is required to validate our findings and provide a more complete analysis. Second, the scoring systems (LAP-VEGaS, JAMA, and GQS) are open to subjective interpretation, which may introduce bias. Although these tools are standardized, variations in individual scorers' assessments may influence the results. Implementing a more objective and automated scoring system could help address this issue. Another limitation is relying solely on YouTube for video content. While YouTube is a popular platform, it does not host educational videos available online. Other platforms, such as specialized medical education websites, may host higher-quality videos that were not considered in our analysis. Future research should consider combining videos from various sources to provide a more balanced evaluation. Furthermore, the study did not take into account the diverse backgrounds and levels of expertise among video creators. Videos produced by experienced surgeons or medical institutions may have a higher educational value than those created by less experienced individuals. A stratified analysis of the creators' credentials could yield more nuanced results. Finally, the study's cross-sectional design limits the ability to infer causality. Longitudinal studies that track the impact of video quality on learning outcomes over time would provide stronger evidence of the educational value of these videos. Despite these limitations, this study provides valuable insights into the current state of educational videos on YouTube and identifies areas for improvement.

Conclusion

We conducted this study to assess the educational quality and reliability of LHCS videos available on YouTube. Several key findings emerged from our research. First, videos with spoken commentary significantly improved educational quality, as evidenced by higher scores on the LAP-VEGaS, JAMA, and GQS systems. This indicates that spoken explanations provide useful context and clarity, making complex procedures more understandable to viewers.

Second, while subtitles were beneficial, they had less of an impact than spoken commentary. This demonstrates that, while subtitles are useful, they cannot completely replace the effectiveness of a well-narrated video. The relationship between user engagement metrics, such as likes and views and educational quality, emphasizes the significance of viewer interaction in determining the value of educational content. Higher engagement typically indicates better educational content, implying that users interact more with videos that contain clear and useful information.

Furthermore, the time since a video was uploaded negatively correlated with educational scores, implying that newer videos may be more current and thus more useful for learning purposes. This finding emphasizes the importance of continuous updates and revisions to keep educational content relevant and accurate.

Overall, this study emphasizes the importance of high-quality, professionally produced educational videos in medical education. It emphasizes the importance of spoken commentary in improving learning experiences and the need for regular updates to keep educational materials relevant. Future efforts should be directed toward improving the production quality and peer-review processes of educational videos to ensure that they meet the educational needs of medical professionals and students.

Ethics

Ethics Committee Approval: As this study did not include human participants or animal experiments, ethical approval was not required.

Informed Consent: As this study did not include human participants or animal experiments, informed consent was not required.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.S.B., H.Y., A.U., Concept: M.S.B., H.Y., A.U., Design: M.S.B., H.Y., A.U., Data Collection or Processing: M.S.B., Analysis or Interpretation: M.S.B., A.U., Literature Search: M.S.B., H.Y., Writing: M.S.B., H.Y.

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Original Article

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The Glasgow Prognostic Score (GPS) May Serve as a Prognostic Indicator in ST-Elevation Myocardial Infarction (STEMI) Patients Undergoing Emergency Coronary Artery Bypass Graft Surgery

Glasgow Prognostik Skoru (GPS) Acil Koroner Arter Bypass Greft Cerrahisi Geçiren ST-Yükselmeli Miyokard Enfarktüsü (STEMİ) Hastalarında Prognostik Bir Gösterge Olabilir

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ABSTRACT

Objective: Ischemic heart disease remains a leading cause of death worldwide. Emergency coronary artery bypass grafting (CABG) is life-saving for ST-elevation myocardial infarction (STEMI) patients unsuitable for percutaneous coronary intervention. This study aimed to evaluate the Glasgow prognostic score (GPS) as a predictor of in-hospital mortality in STEMI patients undergoing emergency CABG. GPS, calculated from serum C-reactive protein (CRP) and albumin levels, reflects systemic inflammation and nutritional status.

Methods: A retrospective analysis included 112 STEMI patients who underwent emergency CABG within 6 hours of symptom onset (2010-2023). Patients were stratified into survivors (n=99)

ÖZ

Amaç: İskemik kalp hastalığı dünyada önde gelen ölüm nedenidir. ST-yükselmeli miyokard infarktüsü (STEMI) hastalarında acil koroner arter bypass greft cerrahisi (CABG), perkütan koroner girişim (PCI) uygun olmayan anatomili veya mekanik komplikasyonlu olgularda hayat kurtarıcıdır. Bu çalışmanın amacı, acil CABG uygulanan STEMI hastalarında Glasgow prognostik skorunun (GPS) hastane içi mortaliteyi öngörmedeki rolünü değerlendirmektir. GPS, serum CRP ve albümin düzeyleriyle hesaplanan, enflamasyon ve nutrisyonel durumu yansıtan basit bir prognostik göstergedir.

Yöntemler: 2010-2023 yılları arasında acil serviste STEMI tanısı alan, PCI için uygun olmayan ve semptom başlangıcından 6

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ABSTRACT

and non-survivors (n=13) based on in-hospital mortality. GPS was categorized (0-2) using albumin (<3.5 g/dL) and CRP (>10 mg/L). Statistical analyses were performed using SPSS 26.0.

Results: Non-survivors had significantly higher GPS ≥1 (76.9% vs. 31.3%, p=0.001). Multivariate analysis identified GPS as an independent predictor of mortality [hazard ratio (HR)=12.820, p=0.037]. Other independent predictor: The Society of Thoracic Surgeons (STS) score (HR =1.565, p=0.041). Non-survivors also exhibited: reduced left ventricular ejection fraction (34.6% vs. 45.5%, p<0.001), elevated white blood cell (21.4 vs. 12×10^6/L, p<0.001), and hemodynamic instability (30.8% vs. 3%, p=0.003).

Conclusion: GPS is a simple, accessible, and independent indicator of in-hospital mortality in STEMI patients requiring emergency CABG. Combining GPS with the STS score may enhance risk stratification and postoperative prognosis prediction. Validation in larger cohorts is warranted. They also had lower glomerular filtration rates (60.7±32.9 vs. 86.6±22.3 mL/min/1.73 m^2, p<0.001).

Keywords: Emergency CABG, ST-elevation myocardial infarction, Glasgow prognostic score, in-hospital mortality, risk stratification

ÖZ

saat içinde acil CABG uygulanan 112 hasta retrospektif olarak incelendi. Hastalar, birincil sonlanım noktası (hastane içi mortalite) temelinde sağ kalanlar (n=99) ve sağ kalmayanlar (n=13) olarak iki gruba ayrıldı. GPS, serum albümin (<3,5 g/dL) ve CRP (>10 mg/L) düzeylerine göre kategorize edildi (GPS 0-2). İstatistiksel analizlerde SPSS 26.0 kullanıldı.

Bulgular: Hayatta kalmayan grubunda GPS ≥1 oranı anlamlı derecede yüksekti (%76,9 vs. %31,3, p=0,001).

GPS, çok değişkenli analizde hastane içi mortalitenin bağımsız öngördürücüsü olarak saptandı [risk oranı (HR)=12,820, p=0,037].

Diğer bağımsız prediktör: Göğüs Cerrahları Derneği (STS) skoru (HR =1,565, p=0,041). Hayatta kalmayan grubunda ayrıca: düşük sol ventrikül ejeksiyon fraksiyonu (%34,6 vs. %45,5, p<0,001), yüksek beyaz kan hücresi (21,4 vs. 12×10^6/L, p<0,001) ve hemodinamik instabilite (%30,8 vs. %3, p=0,003) görüldü.

Sonuç: GPS, acil CABG gerektiren STEMI hastalarında hastane içi mortalitenin basit, erişilebilir ve bağımsız bir belirtecidir. Klinikte risk stratifikasyonu için GPS ve STS skorunun birlikte kullanımı, postoperatif prognozu öngörmede değerli bir araç olabilir. Bu bulguların daha geniş kohortlarda doğrulanması önerilir. Ayrıca glomerüler filtrasyon hızları daha düşüktü (60,7±32,9 vs. 86,6±22,3 mL/dk/1,73 m^2, p<0,001).

Anahtar Kelimeler: Acil koroner arter bypass cerrahisi, ST-yükselmeli miyokard enfarktüsü, Glasgow prognostik skoru, hastane içi mortalite, prognostik belirteç

Introduction

Despite advances in the diagnosis and invasive treatments of ischemic heart disease, it remains the leading cause of death worldwide. Most of these deaths stem from acute ST-segment elevation myocardial infarction (STEMI) and its complications. While primary percutaneous coronary intervention (PCI) is the recommended alternative treatment for acute STEMI, emergency coronary artery bypass graft (CABG) surgery is indicated for patients with anatomy unsuitable for PCI, particularly those with life-threatening myocardial infarction involving complex arterial systems (such as left main disease or multivessel disease) or mechanical complications (1).

Although various studies have evaluated prognostic factors, risk scores, and clinical outcomes in STEMI patients undergoing emergency CABG, most have predominantly focused on anatomical factors. Clinical parameters such as age, creatinine clearance, and left ventricular ejection fraction (LVEF), combined with the angiographic SYNTAX score in the logistic clinical SYNTAX score (log CSS), are known mortality predictors in this population (2).

The Glasgow prognostic score (GPS), a calculated index based on serum C-reactive protein (CRP) and albumin levels, reflects systemic inflammatory activity and nutritional status. It has proven to be a valuable prognostic indicator widely used to determine prognosis in various diseases and surgical interventions (3). Numerous studies have confirmed its utility in terminal malignancy and the postoperative period (4).

Opportunities exist to explore the association between clinical data at the time of emergency department presentation (beyond individual risk parameters) and persistent independent outcome following emergency revascularization with CABG. This study enables the assessment of the relationship between patients' systemic inflammatory profile and nutritional status at presentation and in-hospital mortality.

Methods

Between 2010 and 2023, a total of 124 patients who presented to the emergency department with STEMI, had the diagnosis confirmed by electrocardiogram (ECG), underwent emergency angiography, and subsequently underwent emergency CABG within 6 hours due to anatomy unsuitable for PCI, were retrospectively analyzed. After excluding patients with mechanical complications of STEMI or those requiring concomitant significant valve surgery, 112 patients were included.

Patient demographic information, established risk factors (age, family history, smoking status, hyperlipidemia, hypertension, diabetes), and admission laboratory results were obtained through systematic retrospective review of hospital records. The study protocol was approved by the Local Ethics Committee Scientific Research Ethics Committee of University of Health Sciences

Türkiye, Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (decision no: 2025.04-27, date: 27.06.2025) and was conducted in accordance with the Helsinki Declaration, good practice guidelines, and International Council for Harmonisation guidelines.

STEMI ECG criteria (5): new ST-segment elevation at the J-point in ≥2 contiguous leads with cut-off points of:

>0.1 mV in all leads except V2-V3

>0.2 mV in men ≥40 years (V2-V3)

>0.25 mV in men <40 years (V2-V3)

>0.15 mV in women (V2-V3)

Cardiogenic shock was defined as (6): cardiac arrest, or systolic blood pressure <90 mmHg (persisting despite adequate fluid resuscitation) requiring vasopressors, PLUS signs of end-organ hypoperfusion (altered mental status, oliguria/anuria, elevated serum lactate). The primary end point was in-hospital mortality. Patients were stratified into two groups (survivors vs. non-survivors) and compared for: in the differential diagnosis process, acute pulmonary embolism was systematically excluded in line with the 2019 European Society of Cardiology pulmonary embolism guideline recommendations (4).

- Demographic characteristics
- Cardiovascular risk factors
- Intraoperative parameters
- GPS

GPS calculation (7): the GPS is a prognostic marker reflecting cumulative inflammatory/nutritional status via serum CRP and albumin levels. The cut-off values used - albumin ≤3.5 g/dL (hypoalbuminemia) and CRP ≥10 mg/L (significant systemic inflammation) - are standard values derived from the original definition of GPS and widely accepted in the literature for various clinical prognoses (5).

- **Cut-off values:** Albumin ≤3.5 g/dL; CRP ≥10 mg/L
- **GPS 0:** Normal albumin + normal CRP
- **GPS 1:** Normal albumin + elevated CRP **or** low albumin + normal CRP
- **GPS 2:** Low albumin + elevated CRP

Statistical Analysis

The statistical analysis of the research was performed using Statistical Package for the Social Sciences version 26.0 (SPSS Inc., Chicago, Illinois, USA). To assess the normal distribution of variables, visual methods such as histograms and probability plots were employed alongside the Kolmogorov-Smirnov test. Numerical variables following a normal distribution were presented as mean ± standard deviation, while those not following a normal distribution were presented as median (interquartile range). Categorical variables were expressed as percentages (%). Numerical variables were compared between two groups using the unpaired Student's t-test and Mann-Whitney U test based on the distribution. Categorical variables were compared using the chi-square or Fisher's exact test. To identify determinants of in-hospital mortality, we employed both univariate and multivariate Cox proportional hazards regression models, calculating hazard ratios (HR) and 95% confidence intervals (95% CI). The time-to-event was defined as the duration from the emergency CABG surgery to either in-hospital death (event) or hospital discharge (censored). A significance level of less than 0.05 was considered throughout the study.

Results

A total of 112 patients were included in the study, comprising 99 survivors and 13 non-survivors. The mean age of the study cohort was 57.6±12 years, with a male predominance (68.8%). Demographic characteristics and comorbidities [hypertension, peripheral artery disease (PAD), etc.] were similarly distributed between the two groups (all p>0.05). However, the non-survivor group had significantly higher rates of hemodynamic instability (30.8% vs. 3%, p=0.003) and failed PCI (46.2% vs. 18.2%, p=0.021).

Regarding laboratory findings, non-survivors exhibited significantly elevated white blood cell (WBC) counts and glucose levels (p<0.001 for both). Additionally, non-survivors had lower glomerular filtration rates (GFR) (60.7±32.9 vs. 86.6±22.3 mL/min/1.73 m^2, p<0.001) and significantly reduced LVEF (34.6%±4.3% vs. 45.5%±6.9%, p<0.001).

Comorbidities such as hypertension, PAD, and chronic obstructive pulmonary disease and the baseline demographics, clinical and laboratory characteristics of the study groups are summarized in Table 1.

Table 2 shows the distribution of culprit lesions and intraoperative and postoperative characteristics of the study groups. Regarding the intraoperative data, the average aortic cross-clamp time was significantly shorter in the non-survivor group (36.2±15.9 min vs. 48±18.4 min., p=0.030). There was no significant difference in cardiopulmonary bypass (CPB) time between the two groups. Non-survivors required more intra-aortic balloon pump support (69.2% vs. 34.3%, p=0.015) and had a longer intensive care unit stay (6 days vs. 2 days, p=0.027). Ventilation time was also significantly longer in the non-survivor group (28 hours vs. 9 hours, p<0.001). The postoperative drainage volume and hospital stay duration were similar between the groups.

In the univariate Cox regression analysis, low LVEF, low GFR, high Killip class, high GPS, and high Society of Thoracic Surgeons (STS) score were significant predictors of in-hospital mortality. However, in the multivariate Cox regression model, only high GPS (HR =12.820, p=0.037) and high STS score (HR =1.565, p=0.041) remained as persistent and independent predictors of mortality (Table 3). The distribution of the GPS in hospital survivors and non-survivors is shown in Figure 1.

Table 1. The baseline demographics, clinical and laboratory characteristics of the study groups

	All patients (n=112)	Survivors (n=99)	Non-survivors (n=13)	p-value
Age, years (mean ± SD)	57.6±12	57.6±11.6	57±15.2	0.858
Gender (male), n (%)	77 (68.8)	68 (68.7)	9 (69.2)	0.968
BMI (mean ± SD)	26.1±3.5	26.1±3.5	26.5±3.5	0.650
Hypertension, n (%)	33 (29.5)	28 (28.3)	5 (38.5)	0.449
PAD, n (%)	17 (15.2)	14 (14.1)	3 (23.1)	0.399
CVD, n (%)	9 (8)	8 (8.1)	1 (7.7)	1
COPD, n (%)	16 (14.3)	14 (14.1)	2 (15.4)	0.904
Atrial fibrillation, n (%)	9 (8)	8 (8.1)	1 (7.7)	0.961
Smoking, n (%)	32 (28.6)	29 (29.3)	3 (23.1)	0.641
WBC, 10^6/L (mean ± SD)	13.1±6.6	12±4.2	21.4±13.1	**<0.001**
Hemoglobin, g/dL (mean ± SD)	12.3±2.6	12.5±2.7	11.1±1.4	0.066
Platelets, 10^3/μL (mean ± SD)	239±85.4	235.1±82.5	269.1±103.9	0.179
Albumin, g/dL (mean ± SD)	3.82±0.58	3.86±0.58	3.53±0.52	0.061
CRP, mg/L [median (IQR)]	7.6 (3.6-9.8)	7.1 (3.4-9.3)	11.5 (4.4-53.9)	0.072
Glucose, mg/dL (mean ± SD)	176.2±67.9	168±57.9	238.4±102.9	<0.001
Total cholesterol, mg/dL (mean ± SD)	189.1±37.5	189.4±39.3	186.5±19.1	0.789
LDL-C, mg/dL (mean ± SD)	126.3±32	126.8±33.5	122.5±16.8	0.653
HDL-C, mg/dL (mean ± SD)	38.3±8	38±8.1	40.7±7.1	0.254
Triglyceride, mg/dL (mean ± SD)	173.2±88.2	174.2±91.5	165.2±60.1	0.729
Troponin, ng/mL [median (IQR)]	0.13 (0.04-0.35)	0.12 (0.04-0.27)	0.38 (0.14-0.6)	**0.011**
GFR, mL/min/1.73 m² (mean ± SD)	83.6±25	86.6±22.3	60.7±32.9	**<0.001**
LVEF, % (mean ± SD)	44.2±7.5	45.5±6.9	34.6±4.3	**<0.001**
Q wave on ECG	27 (24.1)	20 (20.2)	7 (53.8)	**0.008**
PR duration, ms (mean ± SD)	149.9±26.3	149.4±26.1	153.5±29.4	0.605
QRS duration, ms (mean ± SD)	90.7±15.5	88.9±14.6	104.4±16	**0.011**
Heart rate, beats/min (mean ± SD)	84.7±15.5	82.2±14.5	103.5±9.4	**<0.001**
Corrected QT duration, ms (mean ± SD)	441.3±38.1	439.6±37	453.9±45	0.205
Previous PCI, n (%)	18 (16.1)	15 (15.2)	3 (23.1)	0.436
Failed PCI, n (%)	24 (21.4)	18 (18.2)	6 (46.2)	**0.021**
Previous stent thrombosis, n (%)	17 (15.2)	16 (16.2)	1 (7.7)	0.687
CPR before surgery, n (%)	5 (4.5)	2 (2)	3 (23.1)	**0.011**
Killip class, n (%)				**<0.001**
I	93 (83)	90 (90.9)	3 (23.1)	
II	6 (5.4)	3 (3)	3 (23.1)	
≥III	13 (11.6)	6 (6.1)	7 (53.8)	
CAD				0.074
1 vessel	12 (10.7)	8 (8.1)	4 (30.8)	
2 vessels	37 (33)	35 (35.4)	2 (15.4)	
3 vessels	37 (33)	33 (33.3)	4 (30.8)	
≥4 vessels	26 (23.2)	23 (23.2)	3 (23.1)	
Cardiogenic shock, n (%)	7 (6.3)	3 (3)	4 (30.8)	**0.003**
STS score (mean ± SD)	6.3±2.3	6.1±2.2	7.6±2.7	**0.024**
GPS				**0.003**
0	71 (63.4)	68 (68.7)	3 (23.1)	
1	28 (25)	20 (20.2)	8 (61.5)	
2	13 (11.6)	11 (11.1)	2 (15.4)	
Glasgow prognostic score, n (%)				**0.001**
GPS=0	71 (63.4)	68 (68.7)	3 (23.1)	
GPS ≥1	41 (36.6)	31 (31.3)	10 (76.9)	

Data are expressed as percentage, mean ± SD, or median (interquartile range)
SD: Standard deviation, BMI: Body mass index, IQR: Interquartile range, CAD: Coronary artery disease, COPD: Chronic obstructive pulmonary disease, CRP: C-reactive protein, CPR: Cardiopulmonary resuscitation, CVD: Cerebrovascular disease, ECG: Electrocardiogram, GFR: Glomerular filtration rate, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, LVEF: Left ventricular ejection fraction, PAD: Peripheral artery disease, PCI: Percutaneous coronary intervention, STS: Society of Thoracic Surgeons, GPS: Glasgow prognostic score, WBC: White blood cell

Table 2. The distribution of culprit lesion, intraoperative and postoperative characteristics of study groups

	All patients (n=112)	Survivors (n=99)	Non-survivors (n=13)	p-value
Culprit lesion				0.678
LMCA	33 (29.5)	28 (28.3)	5 (38.5)	
LAD	77 (68.8)	69 (69.7)	8 (61.5)	
LCX	2 (1.8)	2 (2)	0 (0)	
RCA	0 (0)	0 (0)	0 (0)	
Intraoperative characteristics				
ACC time (min.) (mean ± SD)	46.6±18.5	48±18.4	36.2±15.9	**0.030**
CPB time (min.) (mean ± SD)	85.8±35.9	84.3±35.1	99.1±41	0.231
Grafts per patient (n) (mean ± SD)	2.72±1.02	2.76±0.99	2.46±1.2	0.325
Postoperative characteristics				
Drainage (mL) (mean ± SD)	641.3±160.7	633±157.5	704.6±177	0.132
Hospital stay (days) (mean ± SD)	7.6±4	7.5±3.6	7.9±6.9	0.740
IABP support	43 (38.4)	34 (34.3)	9 (69.2)	**0.015**
ICU stay (days) [median (IQR)]	2 (1-4)	2 (1-4)	6 (1-15)	**0.027**
Ventilation time (h) [median (IQR)]	9 (7-17.3)	9 (6-12)	28 (22-105)	**<0.001**

SD: Standard deviation, IQR: Interquartile range, ACC: Aortic cross-clamp, CPB: Cardiopulmonary bypass, IABP: Intra-aortic balloon pump, ICU: Intensive care unit, LAD: Left anterior descending artery, LCX: Left circumflex artery, LMCA: Left main coronary artery, RCA: right coronary artery

Table 3. Univariate and multivariate Cox proportional hazards regression analyses for predictors of in-hospital mortality

	Univariate analysis			Multivariate analysis		
	HR	95% CI (lower-upper)	p-value	HR	95% CI (lower-upper)	p-value
LVEF	0.750	0.652-0.862	**<0.001**	0.831	0.682-1.013	0.066
GFR	0.954	0.928-0.982	**0.001**	0.984	0.943-1.026	0.453
ICU stay	1.442	1.179-1.764	**<0.001**	1.260	0.890-1.784	0.192
Killip class ≥III	18.083	4.606-71	**<0.001**	7.812	0.429-142.106	0.155
High GPS	7.312	1.880-28.441	**0.004**	12.820	1.172-140.257	**0.037**
STS score (mean ± SD)	1.236	1.014-1.507	**0.036**	1.565	1.020-2.402	**0.041**

SD: Standard deviation, HR: Hazard ratio, ICU: Intensive care unit, CI: Confidence interval, GFR: Glomerular filtration rate, GPS: Glasgow prognostic score, LVEF: Left ventricular ejection fraction, STS: Society of Thoracic Surgeons

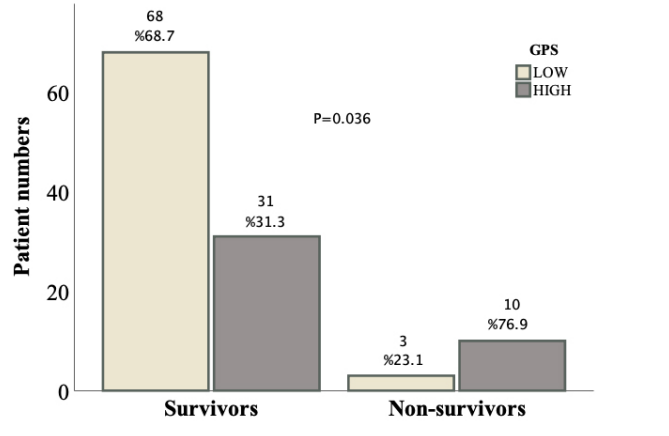

Figure 1. Distribution of the Glasgow prognostic score (GPS) among in-hospital survivors and non-survivors. Bars denote percentages for GPS=0 and GPS ≥1 in each group; group comparison by chi-square test, p=0.001

A higher proportion of non-survivors had a GPS ≥1 (76.9% vs. 31.3% in survivors, p=0.001). Furthermore, the incidence of GPS =0 was significantly higher in survivors (68.7% vs. 23.1% in non-survivors).

Discussion

Our study is among the first to demonstrate that the GPS is a strong and independent predictor of in-hospital mortality in a high-risk cohort such as STEMI patients undergoing emergency CABG. Our multivariate Cox regression analysis results showed that GPS independently predicted mortality (HR =12.820, p=0.037), alongside the STS score a comprehensive risk assessment tool. This finding underscores that risk models based solely on anatomical and standard clinical factors overlook the critical role of systemic inflammation and nutritional derangements in these patients' prognoses.

This prognostic value of GPS can be explained by its underlying biological mechanisms. STEMI and subsequent emergency CABG trigger a massive systemic inflammatory reaction. The significantly elevated WBC counts and blood glucose levels we observed in non-survivors are concrete manifestations of this inflammatory and metabolic stress. Elevated CRP levels reflect an exaggerated inflammatory response to extensive tissue injury. Conversely, hypoalbuminemia (low albumin levels) is not only a marker of poor nutritional status but also reflects impaired synthesis of this negative acute-phase reactant. Low albumin levels directly contribute to reduced oncotic pressure, impaired wound healing, increased capillary leakage, and heightened infection susceptibility. Thus, a high GPS represents a patient profile with diminished capacity to withstand surgical stress and depleted physiological reserves, making increased mortality risk biologically plausible.

Our findings align with other studies in the literature. As expected, the STS score remained a significant predictor of mortality. However, purely anatomical scores like the SYNTAX score are known to be inadequate for predicting prognosis after emergency CABG (8). Dynamic scores incorporating systemic status, like GPS, hold significant potential to fill this gap.

Clinical Implications and Future Research

These results offer important insights for clinical practice. GPS is a cost-effective tool easily calculated from routinely measured CRP and albumin values. Targeted strategies could be developed for high-GPS patients (GPS ≥1), including closer postoperative monitoring, aggressive nutritional support protocols, and proactive screening for potential infection foci. This score may also aid in optimizing intensive care utilization. Future studies should validate our findings in larger, multicenter cohorts. Prospective investigations are needed to comparatively evaluate GPS against established prognostic scores like EuroSCORE II and test its discriminatory power using receiver operating characteristic curve analyses.

Study Limitations

Our study has important limitations. First, its retrospective, single-center design carries inherent risks of selection bias. Second, the low event rate in the non-survivor group (n=13) limits the robustness of our multivariate analyses and may affect generalizability. Third, the study spans a 13-year period (2010-2023). Evolving standards in CPB techniques, anesthesia management, and postoperative care during this timeframe represent a potential confounding factor. Finally, the prognostic value of GPS was not directly compared against other established risk scores like EuroSCORE II.

Conclusion

In our study GPS emerged as an independent predictor of in-hospital mortality in STEMI patients undergoing emergency CABG. This finding demonstrates that GPS may offer potential utility for risk assessment in this high-risk cohort. Incorporating scoring systems like GPS—which evaluate inflammation and nutritional status—into clinical decision-making could enhance prognosis prediction and postoperative management in emergency CABG patients. Clinically, GPS could be pragmatically integrated with existing anatomical and clinical risk scores (such as the STS score) to provide a more comprehensive risk profile. Patients with high GPS may benefit from intensified postoperative monitoring, nutritional support, and proactive complication management strategies. However, broader validation in larger cohorts and diverse subgroups is needed to fully establish GPS's clinical applicability.

Ethics

Ethics Committee Approval: The study protocol was approved by the Local Ethics Committee Scientific Research Ethics Committee of University of Health Sciences Türkiye, Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (decision no: 2025.04-27, date: 27.06.2025).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.Y.S., M.Y., S.A., Concept: N.U., A.S., S.A., Design: N.U., A.S., R.G., N.M., Data Collection or Processing: M.Y.S., R.G., Analysis or Interpretation: M.Y., S.A., N.M., Literature Search: M.Y.S., M.Y., N.M., Writing: N.U., A.S., R.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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Case Report

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Uncovering Parsonage-Turner Syndrome in a Patient Diagnosed with Tendinopathy

Tendinopati Tanılı Bir Hastada Parsonage-Turner Sendromunun Ortaya Çıkarılması

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ABSTRACT

Rotator cuff pathologies are one of the common causes of shoulder pain. However, there are other rare situations that cause pain and limitation in the shoulder. Knowing these pathologies will prevent late or incorrect treatments. Parsonage-Turner syndrome (PTS) (neuralgic amyotrophy, brachial plexitis) is a rare cause of shoulder pain with a frequency of 1.64-3.00 in 100,000. Diagnosis is made by clinical evaluation and electrodiagnostic study. Delayed diagnosis may cause muscle atrophy and functional losses in the patient. The purpose of this case is to increase awareness of PTS, which is a rare condition.

Keywords: Neuralgic amyotrophy, brachial plexus neuritis, shoulder pain, Parsonage-Turner syndrome

ÖZ

Rotator manşet patolojileri omuz ağrısının yaygın nedenlerinden biridir. Ancak nadir de olsa omuzda ağrı ve kısıtlılığa neden olan diğer durumlar da vardır. Bu patolojilerin bilinmesi geç veya yanlış tedavilerin önüne geçecektir. Parsonage-Turner sendromu (PTS) (nevraljik amiyotrofi, brakiyal pleksit) 100.000'de 1,64-3,00 sıklıkta görülen nadir bir omuz ağrısı nedenidir. Tanı, klinik değerlendirme ve elektrodiagnostik çalışma ile konur. Tanı gecikmesi, hastada kas atrofisine ve fonksiyonel kayıplara neden olabilir. Bu vakanın amacı nadir görülen bir durum olan PTS hakkında farkındalığı artırmaktır.

Anahtar Kelimeler: Nevraljik amiyotrofi, brakiyal pleksit, omuz ağrısı, Parsonage-Turner sendromu

Introduction

Parsonage-Turner syndrome (PTS), also referred to as neuralgic amyotrophy or brachial plexitis, is a rare neurological disorder (1). Clinically, it is characterized by acute onset of unilateral shoulder pain, followed by varying degrees of muscle weakness, sensory deficits, and, in more chronic cases, muscular atrophy. The estimated incidence ranges from 1.64 to 3.00 per 100,000 people, although this figure may be unreliable due to challenges in diagnosis, including misdiagnoses, lack of specific biomarkers, and overlap with more common conditions (2).

PTS typically affects individuals between the ages of 30 and 70, with a higher prevalence in males (3). Its pathophysiology remains unclear. Diagnosis is often delayed or incorrect due to its resemblance to more prevalent musculoskeletal issues such as rotator cuff pathologies.

This case report presents an elderly female patient whose symptoms were initially attributed to rotator cuff tendinopathy and who was even considered for surgery before being correctly diagnosed with PTS.

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Case Report

Written informed consent was obtained from the patient for publication of the case report.

A 74-year-old female patient applied to the physical therapy and rehabilitation clinic with complaints of severe pain and weakness in the left shoulder persisting for two weeks. Also, the pain was intense enough to disrupt her sleep. She reported being unable to lift her left arm entirely. There was no history of trauma. She retained mobility in her left elbow, wrist, and fingers. Notably, she had experienced a viral infection approximately one month prior. Her medical history included hypertension but no other significant comorbidities. On physical examination, assessment was limited due to severe pain. Muscle strength in the left shoulder was graded as follows: flexors 4/5, abductors 3/5, adductors 4/5, and extensors 3/5. Passive range of motion was restricted: 70° abduction, 30° adduction, 80° flexion, and 20° each for internal and external rotation. Active movement was preserved in the right shoulder. Sensitivity to touch was present and noted as allodynia. Reflexes were hypoactive. The patient's pain was evaluated as 90 mm with the visual analogue scale (VAS). Neuropathic pain was calculated as 31 with the painDETECT neuropathic pain scale. Routine biochemical and microbiological tests did not detect anything remarkable.

Shoulder magnetic resonance imaging (MRI) performed externally revealed effusion in the subacromial, subdeltoid, and subcoracoid bursae, as well as tendinosis in the supraspinatus and infraspinatus tendons. Based on these findings, the patient was initially recommended for surgery. In another clinic, she was advised complete rest of the left arm for one month. Electroneuromyographic (ENMG) evaluation was recommended for the patient. The ENMG result was reported as brachial plexopathy (brachial plexitis), in which the upper trunk left C5 and C6 roots were affected as shown in Table 1 and Table 2. The electrodiagnostic study showed fibrillation in the left supraspinatus muscle as shown in Table 3. The patient was started on non-steroidal anti-inflammatory drugs (NSAID) and pregabalin, titrated to 150 mg twice daily. A shoulder-focused physical therapy regimen including transcutaneous electrical nerve stimulation (TENS), cold application, and pulsed ultrasound was initiated. The patient was informed that her symptoms were not due to rotator cuff pathology, but rather brachial plexitis. Fifteen days later her VAS score was reduced to 50 mm, allowing the start of joint range of motion exercises. NSAID treatment was discontinued on the 15th day, with pain relief. After one month of exercise, shoulder abduction was 90 degrees, flexion 100 degrees, and internal and external rotations 30 degrees. Pregabalin treatment was continued for 3 months. After three months, the VAS score was evaluated as 30, painDETECT neuropathic pain scale score was 13.

Table 1. Motor nerve conduction study

Nerve	Latency (ms)	Amplitude (mV)	CV (m/s)
Anterior interosseous motor left			
Bl. elbow - Pron. quad / Pron. quad	2.68	2.4	
Ab. elbow - Bl. elbow / Pron. quad	3.29	8	
Anterior interosseous motor right			
Bl. elbow - Pron. quad / Pron. quad	2.57	5.2	
Ab. elbow - Bl.elbow / Pron. quad	2.97	8.1	
Median motor left			
Wrist - APB / APB	3.24	5.4	
Elbow - Wrist / APB	7.94	4.5	44.7
Median motor right			
Wrist - APB / APB	3.84	6.9	
Elbow - Wrist / APB	7.75	6.6	53.7
Ulnaris motor left			
Wrist - ADM / ADM	2.09	6.9	
Ab. elbow - Wrist / ADM	6.98	6.5	45
Bl. elbow - Ab.elbow / ADM	9	6.4	49.5
Ulnaris motor right			
Wrist - ADM / ADM	1.93	10.7	
Ab. elbow - Wrist / ADM	6.48	10.6	50.5
Bl. elbow - Ab. elbow / ADM	8.56	10.3	43.3

Bl: Below, Pron.quad: Pronator quadratus, Ab: Above, APB: Abductor pollicis brevis, ADM: Adductor digiti minimi, CV: Conduction velocity

Table 2. Sensory nerve conduction study

Nerve	Peak latency (ms)	Amplitude (μV)	CV (m/s)
Median sensory left			
Palm - Wrist	4.27	28.5	44.8
Median sensory right			
Palm - Wrist	4.45	41.8	39.5
Ulnaris sensory left			
Dig intravenöz (IV) - Wrist	3.79	14	38.9
Median sensory right			
Dig IV - Wrist	3.6	12.7	37.9

CV: Conduction velocity

Table 3. Needle electroneuromyography

Muscle	Spontaneous activity		
	Fib	PSW	CRD
Right deltoideus post	0/10	0/10	
Left inteross dors	0/10	0/10	
Left biceps	6/10	6/10	
Left triceps	0/10	0/10	
Left supraspinatus	4/10	4/10	4+
Left deltoideus post	4/10	4/10	

PSW: Positive sharp waves, CRD: Complex repetitive discharges, Fib: Fibrillation potentials

Discussion

PTS was first described in the late 19th century and later formalized by Parsonage and Turner (4) in 1948. While relatively uncommon, it remains a frequently missed diagnosis, especially when presenting with symptoms resembling more familiar musculoskeletal issues. It typically begins with sudden and intense shoulder or upper arm pain, followed by progressive weakness in specific muscle groups and sensory disturbances. In some cases, noticeable muscle atrophy develops within weeks.

The pathogenesis of PTS is not fully understood, but a number of accelerating factors have been reported: Infections (particularly viral), vaccination, strenuous activity, surgery, and systemic autoimmune conditions (5). In roughly one-quarter of patients, symptoms follow a recent viral illness. Increasing reports have linked PTS to coronavirus disease 2019 infection and vaccination, supporting its suspected immune mediated nature (6-8). A hereditary form has also been identified, associated with genetic mutations on chromosome 17q25 (9).

In clinical practice, PTS is hard to diagnose due to its overlap with conditions like cervical radiculopathy, rotator cuff pathology, or adhesive capsulitis. These similarities can lead to misdirected interventions, including unnecessary surgeries or prolonged immobilization. Accurate diagnosis hinges on a high level of clinical suspicion and timely use of electrodiagnostic tools. ENMG remains the cornerstone for identifying denervation in affected muscle groups and helps distinguish PTS from compressive or mechanical causes of nerve injury.

Magnetic resonance neurography has shown potential in visualizing inflammatory changes in peripheral nerves, but limited access and high cost restrict its routine use. Importantly, distal sensory and motor nerve conduction studies often appear normal in PTS, as the condition primarily targets proximal nerve segments. This nuance makes localized nerve testing alone insufficient for ruling out PTS. Suprascapular nerve, long thoracic nerve, axillary nerve, and musculocutaneous nerve involvements have been reported in PTS (10,11). In our case, left suprascapular nerve was involved.

In our case, the patient was initially misdiagnosed based on her MRI, which revealed mild degenerative changes that are not uncommon in elderly individuals. These coincidental findings led to a treatment plan that included surgery and prolonged immobilization both of which may have exacerbated her symptoms if pursued. Fortunately, the ENMG results shifted the clinical focus toward the brachial plexus and prompted a more appropriate conservative management approach.

Treatment of PTS is supportive and typically unfolds in two stages. The first aims at pain relief using a combination of pharmacologic agents (NSAIDs, gabapentinoids) and physical modalities (TENS, ultrasound, cold packs) (12-14). Acupuncture has also shown benefit in some cases (5).

The second stage focuses on functional recovery and prevention of complications like contractures. Gentle passive exercises are introduced once pain is under control, but strengthening is deferred until there is evidence of muscle reinnervation. This is essential, as prematurely loading denervated muscles may worsen injury or delay recovery (5).

Recovery in PTS is often gradual. Most patients show partial or full improvement within one to three years, though residual weakness or pain is not uncommon. In one study, 80% of patients recovered within two years, and 89% within three (3). Late diagnoses, like in this case, are associated with longer recovery timelines and an increased risk of incomplete resolution. While surgical tendon transfers may be considered in cases with persistent functional deficits, such procedures are generally reserved for selected and chronic cases.

This case reinforces the importance of looking beyond imaging in patients with shoulder pain especially when clinical features don't fully align with common mechanical diagnoses. Rotator cuff pathology may coexist with PTS, but it should not distract from a broader neurological evaluation when signs like weakness or sensory abnormalities are present. In this case, what initially seemed like a straightforward orthopedic issue turned out to be a complex neuropathic condition. A detailed history, careful examination, and timely ENMG helped avoid an unnecessary surgery and set the patient on a more appropriate recovery path.

Conclusion

PTS is a diagnostic challenge that can easily be mistaken for common orthopedic problems. However, the consequences of missing or mislabeling it can be significant leading to delayed recovery, unnecessary procedures, and prolonged disability. Clinicians should maintain a high index of suspicion, especially in patients with unexplained shoulder pain, weakness, and sensory changes. Early electrodiagnostic evaluation and a multidisciplinary approach are key to ensuring timely diagnosis and optimal patient outcomes.

Ethics

Informed Consent: Written informed consent was obtained from the patient for publication of the case report.

Footnotes

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Letter to Editor

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Immunohistochemical Diagnostic Algorithm for Renal Cell Carcinoma with Fibromyomatous Stroma

Fibromiyomatöz Stromalı Renal Hücreli Karsinom için İmmünohistokimyasal Tanı Algoritması

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Keywords: GATA3, GPNMB, renal cell carcinoma with fibromyomatous stroma, mTOR, TSC1, TSC2, ELOC, TCEB1
Anahtar Kelimeler: GATA3, GPNMB, fibromiyomatöz stromalı renal hücreli karsinom, mTOR, TSC1, TSC2, ELOC, TCEB1

Dear Editor,

Renal cell carcinoma with fibromyomatous stroma (RCC-FMS) is a morphological terminology in an attempt to describe a number of renal neoplasms exhibiting a distinctive biphasic architecture, comprising clear cells arranged in branching tubules and papillary structures within a stroma of smooth muscle-like spindle cells that often express desmin (1-3). Several renal neoplasms including clear cell renal cell carcinoma (CCRCC), clear cell (tubulo) papillary renal cell tumor (CCPRCT), transcription factor binding to IGHM enhancer 3 (TFE3)/transcription factor EB (TFEB) altered RCC, elongin C (ELOC) mutated RCC, tuberous sclerosis complex (TSC)/mechanistic target of rapamycin (mTOR) pathway mutated RCC (either sporadic or TSC-related), and renal hemangioblastoma (1-3). These entities may be subject to significant diagnostic challenge and are critical to accurately diagnose due to the fact that a) neoplasms in the category of RCC-FMS have different expected clinical outcomes, for instance CCPRCT is considered benign, whereas CCRCC is malignant (1-3), b) RCC-FMS related to TSC/mTOR pathway mutations may be associated with germline mutations, i.e. with TSC (1,2,4), and c) neoplasms in this category have positive expression of carbonic anhydrase 9 (CA9), a key immunohistochemical (IHC) assay for CCRCC, frequently requiring additional IHC, cytogenetics and molecular work-up (1-4).

Cytogenetics and molecular assays in the diagnosis of renal neoplasms are often inaccessible for surgical pathologists (1). A tiered diagnostic approach (Figure 1) is recommended, beginning with morphological features as well as CA9 and keratin 7 (KRT7) staining. A CA9-positive (box-like) and KRT7-negative immunophenotype supports a diagnosis of CCRCC (Figure 2 a-d). If both CA9 and KRT7 are negative, TFE3/TFEB altered RCC should be considered in the differential diagnosis.

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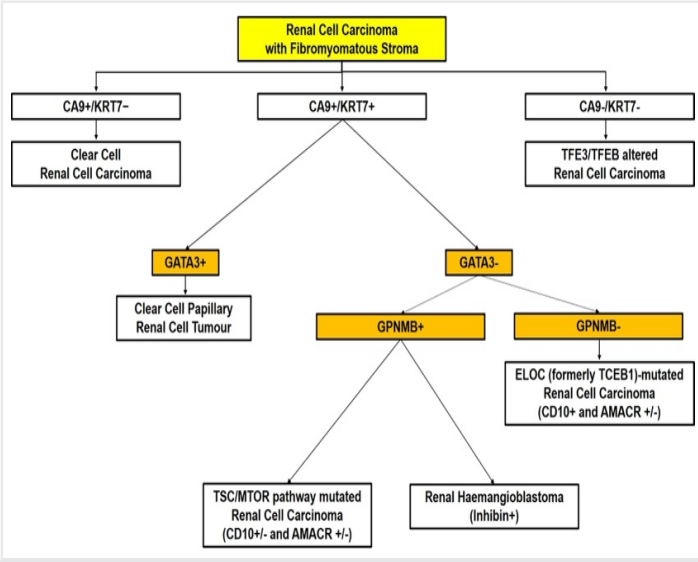

Figure 1. Immunohistochemical diagnostic algorithm for renal cell carcinoma with fibromyomatous stroma

CA9: Carbonic anhydrase 9, KRT7: Keratin 7, GATA3: GATA binding protein 3, GPNMB: Glycoprotein non-metastatic melanoma protein B, ELOC: Elongin C, CD10: Cluster of differentiation 10, AMACR: Alpha-methylacyl-CoA racemase

Co-expression of CA9/KRT7 necessitates further evaluation with an extended panel. A second-tier IHC panel—comprising GATA binding protein 3 (GATA3), glycoprotein non-metastatic melanoma protein B (GPNMB), cluster of differentiation 10 (CD10), and alpha-methylacyl-CoA racemase (AMACR)—can offer valuable diagnostic resolution (1,4,5). GPNMB—a transmembrane glycoprotein associated with melanocytic and histiocytic differentiation—has emerged as a marker for TSC/mTOR pathway–altered renal neoplasms (4). Isolated GATA3 positivity, in the absence of CD10, AMACR, and GPNMB expression, strongly favors a diagnosis of CCPRCT (Figure 2 e-h). In contrast, diffuse GPNMB expression, with or without weak GATA3 staining and variable CD10 or AMACR expression, supports a diagnosis within the spectrum of TSC/mTOR pathway-related renal neoplasms, including TSC/mTOR-related RCC and renal hemangioblastoma (4). A profile demonstrating GPNMB and inhibin co-positivity alongside absent GATA3 is suggestive of renal hemangioblastoma, while CD10 positivity in the absence of both GATA3 and GPNMB raises suspicion for ELOC-mutated RCC (1,4). Our understanding in RCC-FMS continues to evolve and requires stepwise algorithmic approach with emerging immunophenotypic markers, along with more utilized and conventional markers, such as GPNMB and GATA3.

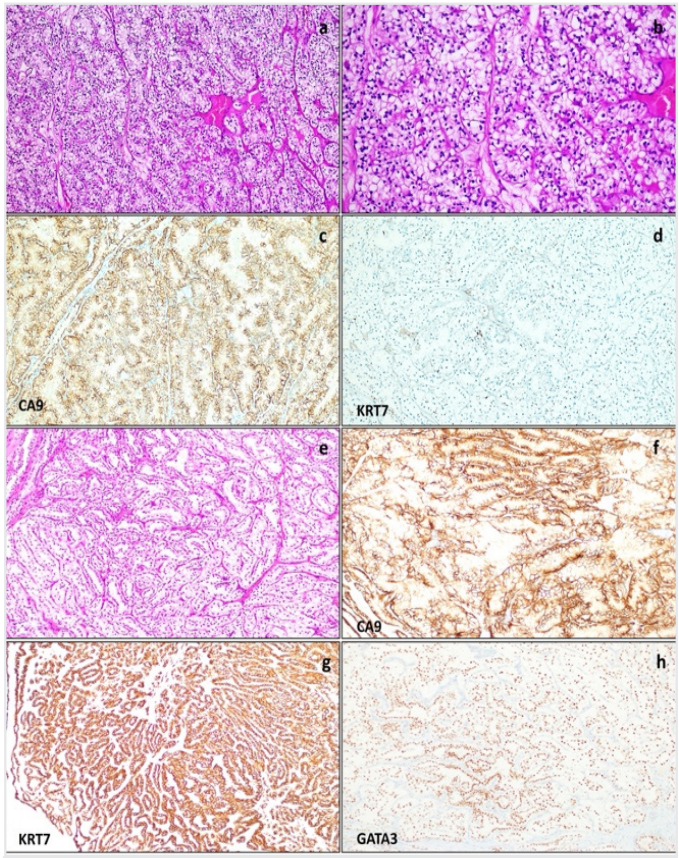

Figure 2. Histopathological and immunohistochemical features of renal cell carcinomas with fibromyomatous stroma

(a,b) Clear cell renal cell carcinoma (CCRCC) shows nests of clear cells (H&E)

(c,d) CCRCC is positive for CA9, with a box-like membranous staining pattern, and negative for KRT7

(e,f) Clear cell papillary renal cell tumor (CCPRCT) exhibits papillary architecture (H&E) and strong CA9 positivity showing a cup-like staining pattern

(g,h) CCPRCT shows diffuse KRT7 and nuclear GATA3 positivity

H&E: Hematoxylin and eosin, CA9: Carbonic anhydrase 9, KRT7: Keratin 7, GATA3: GATA binding protein 3

Footnotes

Authorship Contributions

Surgical and Medical Practices: B.Y.B., M.A., Concept: B.Y.B., M.A., Design: B.Y.B., M.A., Data Collection or Processing: B.Y.B., M.A., Analysis or Interpretation: B.Y.B., M.A., Literature Search: B.Y.B., M.A., Writing: B.Y.B., M.A.

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