

Volume 11 | November 2025 | Number 2 | ISSN 2303-8616

HEALTH BULLETIN

Zdravstveni glasnik



Faculty of Health Studies
University of Mostar

Health Bulletin

Zdravstveni glasnik

Faculty of Health Studies

University of Mostar

Fakultet zdravstvenih studija

Sveučilište u Mostaru

Publishers:

[University of Mostar](#)
[Faculty of Health Studies](#)
PRES 

For the publisher:

Professor Ivo Čolak, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Vajdana Tomić](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina

Editor-in-Chief: Academician Professor [Dragan Babić](#)  MD, PhD, University of Mostar, Bosnia and Herzegovina

Assistant Editors:

Professor [Josip Šimić](#)  PhD,
University of Mostar, Bosnia and Herzegovina
Assistant Professor [Darjan Franjić](#)  PhD,
University of Mostar, Bosnia and Herzegovina
Assistant Professor [Robert Perković](#)  PhD,
University of Mostar, Bosnia and Herzegovina

Editorial Board:

Professor [Ivan Ćavar](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Vesna Miljanović Damjanović](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Miro Miljko](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Joško Petričević](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Vesna Šeper](#)  PhD,
University of Applied Sciences "Lavoslav Ružička"
Vukovar, Croatia
Professor [Violeta Šoljić](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Nikica Šutalo](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Vajdana Tomić](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Assistant Professor [Romana Barbarić](#)  MD, PhD,
University Clinical Hospital Mostar, Bosnia and Herzegovina
Assistant Professor [Shpend Haxhibeqiri](#)  MD, PhD,
University of Pristina, Kosovo
Assistant Professor [Antonija Hrkać](#)  PhD,
University of Mostar, Bosnia and Herzegovina
Assistant Professor [Ivona Ljevak](#)  PhD,
University of Mostar, Bosnia and Herzegovina
Assistant Professor [Martina Orlović Vlaho](#)  MD,
PhD, University of Mostar, Bosnia and Herzegovina
Assistant Professor [Olivera Perić](#)  RN, PhD,
University of Mostar, Bosnia and Herzegovina
Assistant Professor [Nada Prlić](#)  PhD,
Josip Juraj Strossmayer University of Osijek, Croatia
Assistant Professor [Mirna Žulec](#)  MD, PhD,
Catholic University of Croatia, Croatia
Senior Assistant [Valentina Novak](#)  ,
University North, Croatia
Senior Assistant [Dragana Rašić](#)  ,
University of Mostar, Bosnia and Herzegovina

Scientific Advisory Board:

Professor [Milenko Bevanda](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Krunoslav Capak](#)  MD, PhD, Croatian
Institute of Public Health - Zagreb, Croatia
Professor Ivo Čolak, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Jürgen Deckert](#)  MD, PhD,
University Hospital Würzburg, Germany
Professor [Miroslava Jašović Gašić](#)  MD, PhD,
University of Belgrade, Serbia
Professor [Dalibor Karlović](#)  MD, PhD,
University of Zagreb, Croatia
Professor Ante Kvesić, MD, PhD, University
Clinical Hospital Mostar, Bosnia and Herzegovina
Professor [Boris Lukšić](#)  MD, PhD,
University of Split, Croatia
Professor [Josip Mašković](#)  MD, PhD, University
Clinical Hospital Mostar, Bosnia and Herzegovina
Professor [Slobodan Mihaljević](#)  MD, PhD,
University Hospital Centre Zagreb, Croatia
Professor [Mladen Mimica](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor Ljerka Ostojić, MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Sandra Pavičić Žeželj](#)  , PhD,
University of Rijeka, Croatia
Professor [Danijel Pravdić](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Marco Sarchiapone](#)  MD, PhD,
University of Molise, Italy
Professor [Zoran Tomić](#)  PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Ivan Vasilj](#)  MD, PhD,
University of Mostar, Bosnia and Herzegovina
Professor [Danica Železnik](#)  PhD, Faculty of
Health and Social Sciences Slovenj Gradec, Slovenia

Technical Editors:

Senior Assistant [Vladimir Ruf](#)  ,
University of Mostar, Bosnia and Herzegovina
[Sanja Brkić](#)  MPT,
University of Mostar, Bosnia and Herzegovina

English Language Editor: Assistant Professor
[Kaja Mandić](#)  PhD, University of Mostar,
Bosnia and Herzegovina

[Fakultet zdravstvenih studija Sveučilišta u Mostaru /
Faculty of Health Studies, University of Mostar](#)

Zrinskog Frankopana 34, 88000 Mostar, Bosna i
Hercegovina

Tel: +387 36 337 063; **Fax:** +387 36 337 051

E-mail: zdravstveni.glasnik@fzs.sum.ba

Health Bulletin is visible in BASE; Bibliovigilance; COBISS;
Crossref; EBSCO (CEEAS); EBSCO (CINAHL Ultimate); ERIH
PLUS; EuroPub; EZB; Google Scholar; HRČAK; HINARI –
Research4Life; Index Copernicus; Jisc (former
SHERPA/RoMEO), NAFER Academic; OpenAlex; ROAD;
Semantic Scholar; WorldCat; ZDB databases and services.



All papers from Health Bulletin are
licensed under a [Creative Commons
Attribution 4.0 International](#).

HEALTH BULLETIN

Zdravstveni glasnik

**Faculty of Health Studies
University of Mostar**

**Fakultet zdravstvenih studija
Sveučilište u Mostaru**

CONTENTS

Editorial	
Dragan Babić	
EDITORIAL.....	7
Original Scientific Article	
Romana Barbarić, Miro Jakovljević, Dragan Babić, Darjan Franjić, Marina Ćurlin, Marija Brajković	
POSTTRAUMATIC EMBITTERMENT SYNDROME IN PATIENTS WITH POST- TRAUMATIC STRESS DISORDER	8
Original Scientific Article	
Maja Arđelan	
IMPROVING THE QUALITY OF HEALTH CARE IN UROLOGY THROUGH THE INTEGRATION OF MANAGERIAL, EDUCATIONAL AND INNOVATIVE APPROACHES.....	26
Original Scientific Article	
Leonarda Ereš & Andrej Galić	
RADIOLOGICAL TREATMENT OF HANDS IN RHEUMATOID ARTHRITIS.....	37
Original Scientific Article	
Martina Bošnjak, Majo Ćeško, Dragan Babić, Emil Babić, Darjan Franjić	
MENTAL HEALTH IN PATIENTS WITH INFLAMMATORY BOWEL DISEASES.....	47
Original Scientific Article	
Ivana Gusar & Josipa Gregov	
NURSING DOCUMENTATION IN HOSPITAL HEALTHCARE: INSIGHTS INTO NURSES' ATTITUDES AND PERCEPTIONS.....	57
Original Scientific Article	
Marko Krpan, Bruno Rajić, Marin Brajković	
THYROID SCINTIGRAPHY. INCIDENCE OF THYROID CARCINOMA IN COLD NODE	69
Original Scientific Article	
Vedrana Grbavac, Marija Mandić, Marija Govorko, Vinka Lučić, Nikolina Slišković	
DIETARY HABITS OF PHYSIOTHERAPISTS.....	80
Professional Paper	
Toni Džeba	
THE ROLE OF MRI, MSCT AND PET/CT DIAGNOSTIC IMAGING IN THE FOLLOW- UP OF PATIENTS WITH METASTATIC BREAST CARCINOMA.....	92

Professional Paper	
Marin Brajković, Gojko Bogdan, Marko Krpan, Bruno Rajič	
ARTIFICIAL INTELLIGENCE IN THE ROLE OF STROKE DETECTION IN HERZEGOVINA-NERETVA CANTON.....	102
Professional Paper	
Andrea Božurić & Mateja Briševac	
THE IMPACT OF PHYSICAL ACTIVITY ON QUALITY OF LIFE AND MENTAL HEALTH	109
Professional Paper	
Asad Herić	
ADVANCEMENTS AND CLINICAL IMPLICATIONS OF OOCYTE IN VITRO MATURATION IN ASSISTED REPRODUCTIVE TECHNOLOGIES: A COMPREHENSIVE REVIEW OF PROTOCOLS, APPLICATIONS, AND FUTURE PERSPECTIVES.....	117
Case Report	
Branko Krišto, Ivana Vidović, Ana Vukoja, Mirko Maglica	
POSTOPERATIVE SEEDING OF LARYNGEAL SQUAMOUS CELL CARCINOMA: A CASE REPORT	129

EDITORIAL

Dear esteemed readers of our journal,

You are now reading the twenty-second issue of the Health Bulletin, our electronic journal in which we once again present a curated selection of contributions from the field of healthcare. We remain committed to upholding the standards we have reached and are continuously working to further enhance the quality of our publication. We are pleased and proud that the journal is indexed in more than twenty online databases and services and that we continue to advance each year.

This issue features twelve high-quality articles (seven original research papers, four professional papers, and one case report) authored by our current and former students, as well as our doctoral candidates and academic staff. We are also delighted to note that we have expanded our pool of contributors and welcomed several new authors.

I hope that the Health Bulletin will enrich your understanding of the presented topics, support your professional practice, and inspire you to submit your own work to our journal. I extend my sincere gratitude to everyone who contributed to the preparation of this issue, and I warmly welcome all interested authors to submit manuscripts for our future editions, which are published exclusively in English.

Mostar, November 2025

Dragan Babić

POSTTRAUMATIC EMBITTERMENT SYNDROME IN PATIENTS WITH POST-TRAUMATIC STRESS DISORDER

Romana Barbarić^{1,2} , Miro Jakovljević³ , Dragan Babić^{2,4} ,
Darjan Franjić⁴ , Marina Ćurlin⁴ , Marija Brajković⁴ 

¹Department of Psychiatry, University Clinical Hospital Mostar, 88 000 Mostar, Bosnia & Herzegovina

²Faculty of Medicine, University of Mostar, 88 000 Mostar, Bosnia & Herzegovina

³School of Medicine, University of Zagreb, 10 000 Zagreb, Republic of Croatia

⁴Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia & Herzegovina

Received on 10.6.2025.

Reviewed on 26.6.2025.

Accepted on 2.7.2025.



SUMMARY

Introduction: Post-traumatic embitterment syndrome is a pathological reaction to drastic life events and does not have the tendency to end. This syndrome also occurs relatively frequently in patients with post-traumatic stress disorder (PTSD).

Aim: To investigate post-traumatic embitterment syndrome in patients with post-traumatic stress disorder.

Subjects and methods: A cross-sectional study was conducted on a sample of 200 subjects who were participants in the past war. The research group consists of 100 subjects who participated in the war and have a diagnosis of PTSD, and the control group consists of 100 healthy volunteers who were in the war but were not previously diagnosed with PTSD.

The study used a sociodemographic questionnaire, a self-assessment questionnaire for post-traumatic embitterment syndrome, and a clinical questionnaire for post-traumatic stress disorder.

Results: Subjects with PTSD show a statistically significantly higher level of post-traumatic embitterment syndrome compared to subjects without PTSD. There were no statistically significant differences between the groups that actively and passively participated in the war, between genders, and between the groups with current PTSD and lifetime PTSD.

Conclusion: Subjects with PTSD show a statistically significantly higher level of post-traumatic embitterment syndrome compared to subjects without PTSD.

Keywords: post-traumatic embitterment syndrome, patients, post-traumatic stress disorder

Corresponding author: Assistant Professor Romana Barbarić, MD, PhD, Psychiatrist;

romana.babic@gmail.com

INTRODUCTION

Numerous catastrophic stressors during the past war in Bosnia and Herzegovina (BiH) had, almost as a rule, a negative impact on human health. Even though 30 years have passed since the war, many war participants still show various psychological symptoms that are the consequences of catastrophic war trauma. Active war participants, especially prisoners of war, wounded, and displaced persons, suffered more than others (1). A characteristic of the war that took place in BiH from 1992 to 1995 is multitraumatization, since there are many of those who were in captivity, displaced, wounded, or otherwise traumatized. Although numerous individual studies were conducted in BiH in the post-war period, no valid documentation or data on systematic research on the consequences of war trauma at the state level exists. Secondary traumatization and systemic stress, quality of life, and burnout in the marriage of traumatized persons have been investigated and described (1-4); the connection between PTSD and aggression, alcoholism, metabolic syndrome and current doubts regarding PTSD (5-8). Kučukalić A (9), Hasanović M (10,11) and many others have also written about various aspects of the psychological consequences of war. In the Republic of Croatia, since the beginning of the war until today, numerous works have been published and various aspects of war trauma have been investigated (12-16). Dealing with and studying the consequences of war has become very topical, with numerous research being conducted and numerous scientific papers being published on the topic of PTSD all over the world (17-19).

PTSD is one of the rare mental disorders for which the cause is known. It is an extremely severe catastrophic trauma that is outside the circle of everyday and common stressful experiences and which leads to intense fear and helplessness. Unlike most disorders, the diagnosis of PTSD relies on the simultaneous association of symptoms with a previous “traumatic” event. People suffering from PTSD continuously and uncontrollably re-experience distressing elements of the traumatic event in the form of intrusive memories and the presence of constant fear (20). Previous research has identified various risk factors that contribute to the development of this disorder, and they arise from the interaction of various personality traits and coping strategies and the individual's recovery ability, psychiatric history and comorbid conditions such as personality disorders, beliefs, and biological factors and social circumstances (21).

Mainstream medicine took a long time to accept the reality that extremely severe and catastrophic stress can lead to temporary or permanent mental disorders. There were some indications in the past that this might be accepted, but it can be said that the beginning of acceptance by mainstream medicine was in 1980. That year, post-traumatic stress disorder was published as a psychiatric nosological entity in the third edition of the Diagnostic and Statistical Manual of Mental Health (DSM-III) of the American Psychiatric Association (22). Only then was it understood that not only weaklings and cowards break down mentally, but that anyone can break down mentally, and it was officially accepted that extreme stress can cause mental disorders. Mainstream medicine accepted

what lay people had known and claimed before and what had existed throughout human history and which is evidenced by numerous literary works.

Post-traumatic embitterment disorder (PTED) is a pathological reaction to drastic life events and does not have the tendency to end. The trigger is an extraordinary negative life event, such as divorce, dismissal, personal insult or belittling. The consequence is severe and long-lasting embitterment. This disorder is divided, not according to the content of the trigger, but according to the temporal connection to the incident. The German psychiatrist Michael Linden (23) and others have emphasized the importance of embitterment. Embitterment is an emotion that is familiar to everyone as a negative feeling in the face of negative life events. People understand what is meant by “embitterment” without professional training, just as everyone knows what fear and anger are. Embitterment, like anxiety, is a reaction to injustice, insult or distrust. Embitterment is tormenting and does not tend to end. In many cases, embitterment fades, while in others it recurs constantly as the event is renewed. With greater intensity, it can limit the entire life and environment with its severe impairment (24-27).

After a unique negative stressful life event, emotional symptoms or behavioral problems such as embitterment, feelings of betrayal, injustice, and aggression toward the perpetrator appear. The diagnosis is made by clinical examination and psychological testing (28). Preliminary results indicate a prevalence of about 2-3% in the general population. Any therapist, social law expert, or lawyer knows of such cases. Increased prevalence is observed

when a larger group of people represents the subject of social upheaval. Linden first described this condition after the reunion of Germany (24-26). Embitterment occurs as a reaction to extraordinary, but nevertheless everyday, negative life events such as divorce or dismissal (29).

Treatment of reactive disorders, especially PTED, can be difficult. Embitterment often coincides with a refusal to help. Therapy is often complicated by the patients' fatalistic and aggressive attitudes, which slows down the development of new life perspectives or new perspectives on what has happened. Patients with PTED must learn how to cope with their negative experiences. Cognitive therapy has many established treatment strategies in this regard, such as reframing methods, altering internal dialogue, reality testing, increasing self-efficacy, exposure exercises, problem-solving strategies, and methods for re-establishing social contacts and increasing activity (30). There are particular problems in using such conventional methods with PTED patients, as they respond differently from many other patients, necessitating modification of conventional cognitive interventions. Based on theoretical considerations about the etiology of PTED, and on available empirical findings and clinical experience, we developed “wisdom therapy,” a treatment regimen specifically for PTED (31).

The first therapeutic task is to develop a working relationship between the therapist and the embittered patient, who is often distrustful, fatalistic, cynical, and mocking, and who rejects offers of help. In their view, the world must change, not the patient. They may accept treatment if they perceive the therapist as someone who can help find justice. It is important for the

therapist to convey that they appreciate the patient's suffering and clearly understand that an injustice has occurred. This is done so that the patient does not feel that they have to justify themselves again. Treatment of PTED initially requires a lot of empathy and unconditional acceptance from the physician (32).

RESEARCH GOALS

To investigate the posttraumatic resentment syndrome in patients with posttraumatic stress disorder.

SUBJECTS AND METHODS

Subjects

A cross-sectional study was conducted on a sample of 200 subjects who participated in the past war. The study included subjects of both sexes aged 35-65 years. All subjects who were suitable for participation in the study were briefly explained the purpose and goal of the study, and informed consent was requested for participation. Exclusion factors were: refusal to voluntarily participate in the study, and a diagnosis of mental illness, mental disorder, and mental retardation made before the war, age less than 35 and greater than 65 years.

The subjects were divided into two groups. The research group consisted of 100 subjects who participated in the war and had a diagnosis of PTSD made by an experienced psychiatrist in accordance with the diagnostic criteria of ICD 10, treated in outpatient and inpatient conditions at the Psychiatric Clinic of University Clinical Hospital Mostar.

The control group (N=100) consisted of healthy volunteers who had been in the war but had no prior diagnosis of PTSD. The control group was recruited using the

“snowballing” method. The snowballing method is a “snowball” sampling method where the initial study subjects recruit future subjects from among their acquaintances. In this way, the sample size increases like a rolling snowball. This technique is often used in hidden populations where access is difficult for researchers (43).

Diagnostic instruments

1. The sociodemographic questionnaire consists of questions about gender, age, place of residence during the war, participation in the war, professional education, employment status, occupation, marital status, and current place of residence. The questionnaire was personally designed and specifically created for this study.
2. The Post-Traumatic Embitterment Disorder Self-Rating Scale (PTED) consists of 19 statements to which one answer can be circled from 0 to 4, where 0 represents “does not apply to me at all” and 4 “applies to me completely” and its aim is to assess the level of embitterment caused by negative life events (44).
3. Clinical Questionnaire for Posttraumatic Stress Disorder, Diagnostic Version for Current and Lifetime PTSD (ClinicianAdministred PTSD Scale, CAPS-DX) – Croatian version adapted for assessing the type and severity of PTSD symptoms in soldiers and civilians in accordance with the DSM V classification. It consists of 25 items that encompass PTSD symptoms, according to B, C, D criteria of DSM V. For each item, the respondent assesses the frequency and intensity. Criterion A is for a catastrophic traumatic event, criterion E speaks about the duration of the disturbances, and

criterion F assesses the personal experience of the disturbances, disruption of social and work functioning. The points achieved on the CAPS indicate the type and severity, and the presence/absence of the disorder (45).

Statistical analysis

The obtained results were processed using descriptive, non-parametric and parametric statistical methods depending on the data distribution. The chi-square test, student t-test, one-way analysis of variance were used to test the difference between groups. Appropriate correlation tests and regression analysis were used to determine the relationship between variables. The sample distribution was tested using the Kolmogorov-Smirnov test. A probability

level of $p < 0.05$ will be considered as statistically significant.

RESULTS

Sociodemographic characteristics of the sample

Table 1 shows the differences in sociodemographic characteristics between the groups with and without PTSD. Subjects with PTSD were significantly more likely to be unemployed and retired, had a higher divorce rate, and were less likely to have resolved their housing issues; there were no statistically significant differences in the other variables shown in the table.

Table 1. Sociodemographic Characteristics of the Sample, Group With and Without PTSD

	Group				χ^2	p
	No PTSD		PTSD			
	N	%	N	%		
Sex					0	1
M	89	88,1	88	88,9		
F	12	11,9	11	11,1		
Participation in combat					1,051	0,305
Active	79	78,2	84	84,8		
Passive	22	21,8	15	15,2		
Job					27,966	<0,001*
Paid employment	50	49,5	15	15,2		
Retired	30	29,7	51	51,5		
Unemployed	20	19,8	32	32,3		
Other	1	1,0	1	1,0		
Marriage					9,825	0,013*
Married	87	86,1	78	78,8		
Single	13	12,9	10	10,1		
Divorced	0	0,0	7	7,1		
Lives with partner	1	1,0	4	4,0		
Housing conditions					16,088	0,003*
House/apartment owned	84	83,2	68	68,7		
House/apartment owned by spouse	6	5,9	1	1,0		
Rented house/apartment	3	3,0	9	9,1		
At parents' house	8	7,9	14	14,1		
Collective center	0	0,0	5	5,1		
Temporary accomodation assigned by the government	0	0,0	2	2,0		
Smoking					0,303	0,582
No	61	60,4	55	55,6		
Yes	40	39,6	44	44,4		

*Fisher's exact test

Table 2. Sociodemographic Characteristics of the Sample, Group With and Without PTSD

	Group				t	p
	No PTSD		PTSD			
	$\bar{X}$	SD	$\bar{X}$	SD		
Age	51,82	7,549	50,96	6,700	0,854	0,394
Years of education	12,19	1,963	11,51	2,305	2,258	0,025
Income	1149,01	686,731	734,34	451,112	5,057	<0,001
Household members	4,19	1,759	3,72	1,623	1,967	0,051
Children	2,13	1,426	1,94	1,300	0,981	0,328

Table 2 shows the differences in sociodemographic characteristics between the groups with and without PTSD. Subjects with PTSD had significantly

lower incomes, while there were no statistically significant differences in the other variables shown in the table.

Table 3. Sociodemographic Characteristics of Groups With Active and Passive Combat Participation

	Combat participation				χ^2	p
	Active		Passive			
	N	%	N	%		
Sex					85,988	<0,001*
M	161	98,8	16	43,2		
F	2	1,2	21	56,8		
Job					6,859	0,069*
Paid employment	52	31,9	13	35,1		
Retired	72	44,2	9	24,3		
Unemployed	37	22,7	15	40,5		
Other	2	1,2	0	0,0		
Marriage					1,064	0,845*
Married	135	82,8	30	81,1		
Single	19	11,7	4	10,8		
Divorce	5	3,1	2	5,4		
Lives with partner	4	2,5	1	2,7		
Housing conditions					14,772	0,005*
House/apartment owned	127	77,9	25	67,6		
House/apartment owned by spouse	3	1,8	4	10,8		
Rented house/apartment	7	4,3	5	13,5		
At parents' house	21	12,9	1	2,7		
Collective center	3	1,8	2	5,4		
Temporary accomodation assigned by the government	2	1,2	0	0,0		
Smoking					0,125	0,723
No	96	58,9	20	54,1		
Yes	67	41,1	17	45,9		

*Fisher's exact test

Table 3 shows the differences in sociodemographic characteristics between the groups with active and passive participation in the war. A significantly higher rate of women was in the group with passive participation in the war, a

significantly lower percentage of subjects with passive participation had their housing issue resolved, and there were no statistically significant differences in the other variables shown in the table.

Post-traumatic embitterment syndrome

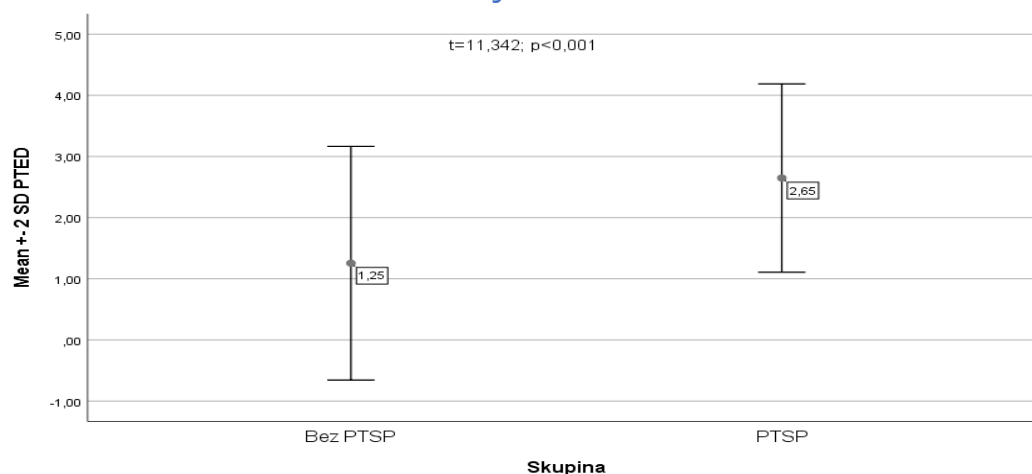


Figure 1. PTED levels between groups with and without PTSD

The figure shows the differences in PTED levels between groups with and without PTSD, as can be seen in the figure,

subjects with PTSD had significantly higher PTED levels compared to subjects without PTSD.

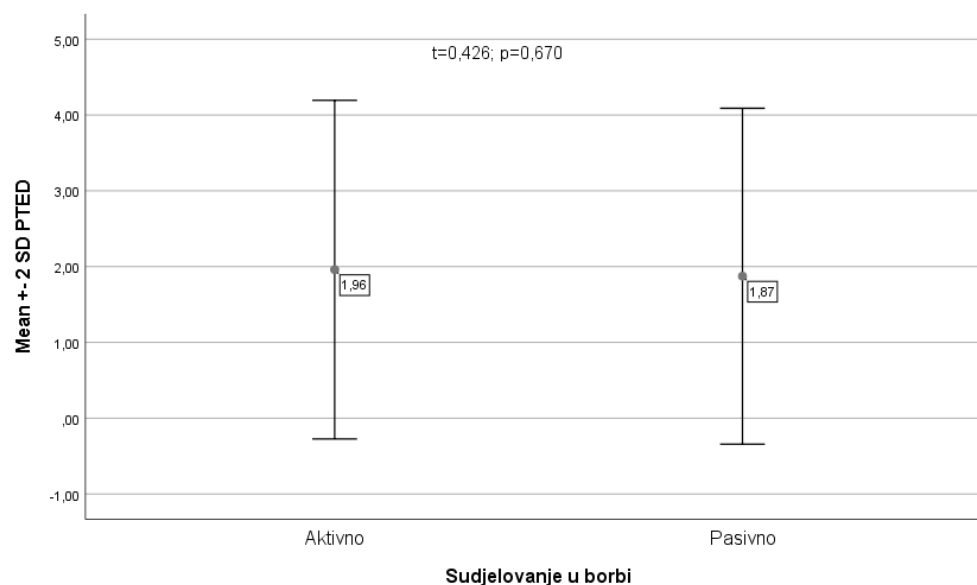


Figure 2. Level of PTED between groups that actively and passively participated in the war

The figure shows the differences in the level of PTED between the groups that actively and passively participated in the

war. As can be seen in the figure, there were no statistically significant differences between the groups.

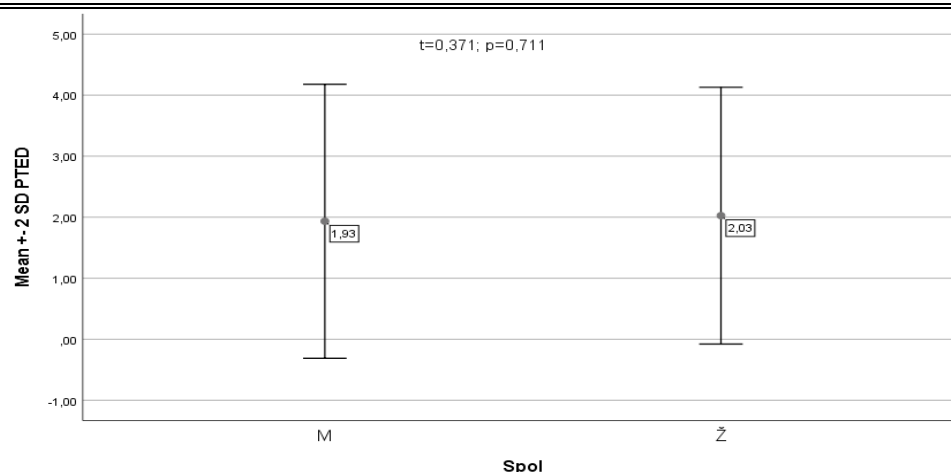


Figure 3. *PTED levels between sexes*

The figure shows the differences in PTED levels between sexes. There were no

statistically significant differences between the groups, as can be seen in the figure.

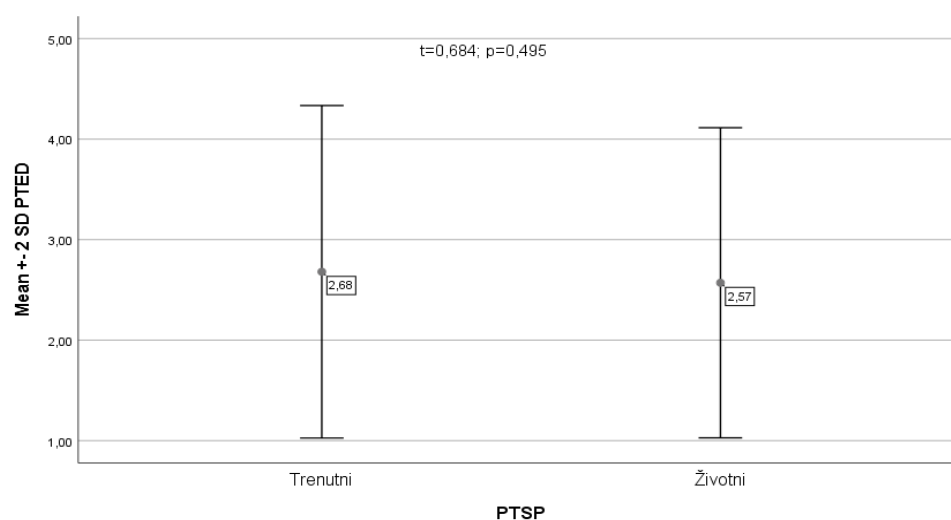


Figure 4. *PTED level between groups with current and lifetime PTSD*

The figure shows the differences in PTED level between groups with current and lifetime PTSD. There were no statistically

significant differences between the groups as can be seen in the figure.

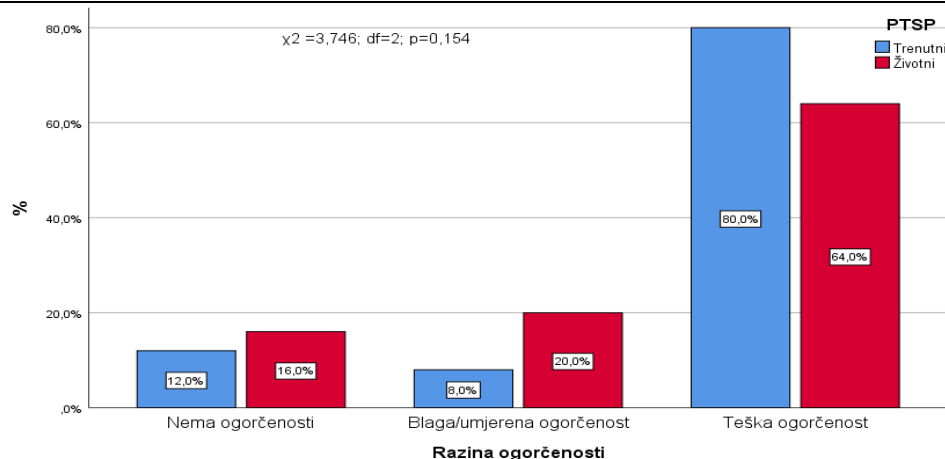


Figure 5. PTED scores between groups with current and lifetime PTSD

The figure shows the differences in PTED scores between groups with current and lifetime PTSD. As can be seen in the

figure, there were no statistically significant differences between the groups.

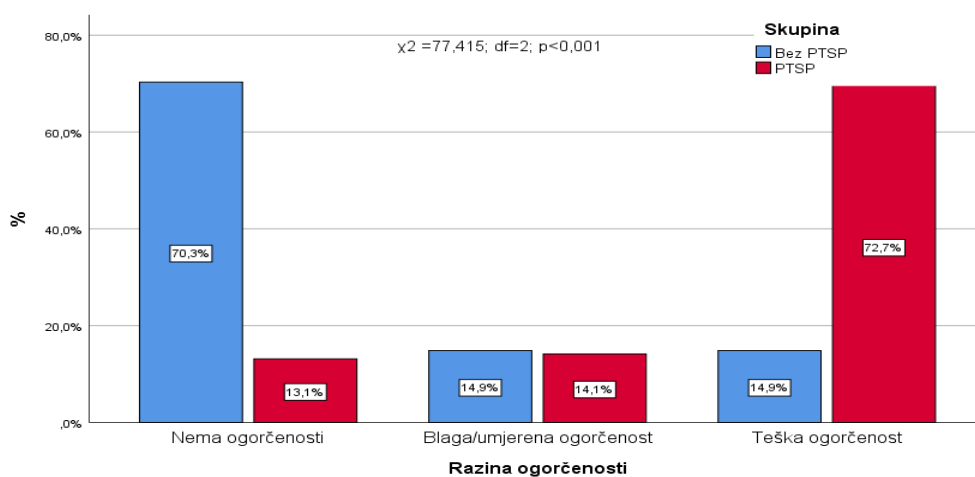


Figure 6. PTED scores between PTSD and non-PTSD groups

The figure shows the differences in PTED scores between PTSD and non-PTSD groups. As can be seen in the figure, subjects without PTSD were most represented in the non-embitterment group,

while those with PTSD were most represented in the severe embitterment group. The observed differences were statistically significant.

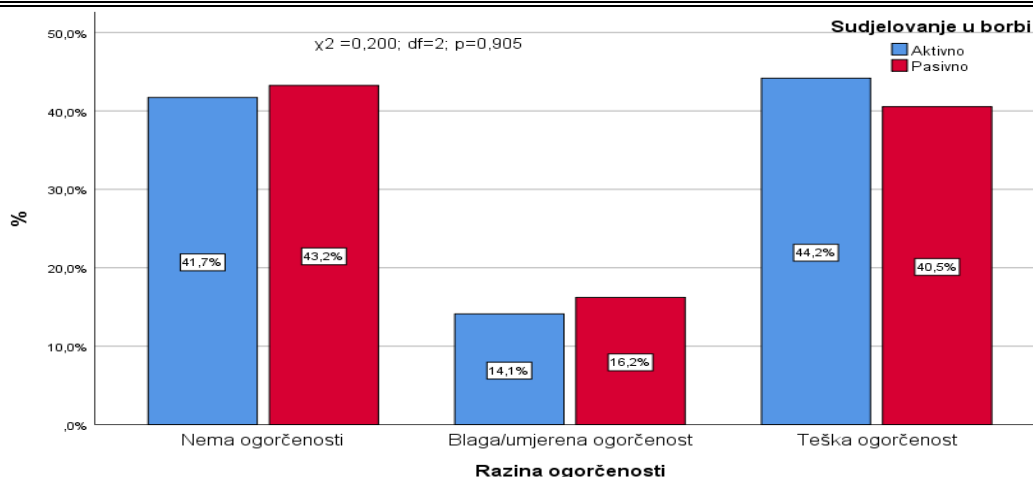


Figure 7. Level of PTED between groups that actively passively participated in the war

The figure shows the differences in the level of PTED between groups that actively and passively participated in the

war. As can be seen in the figure, there were no statistically significant differences between the groups.

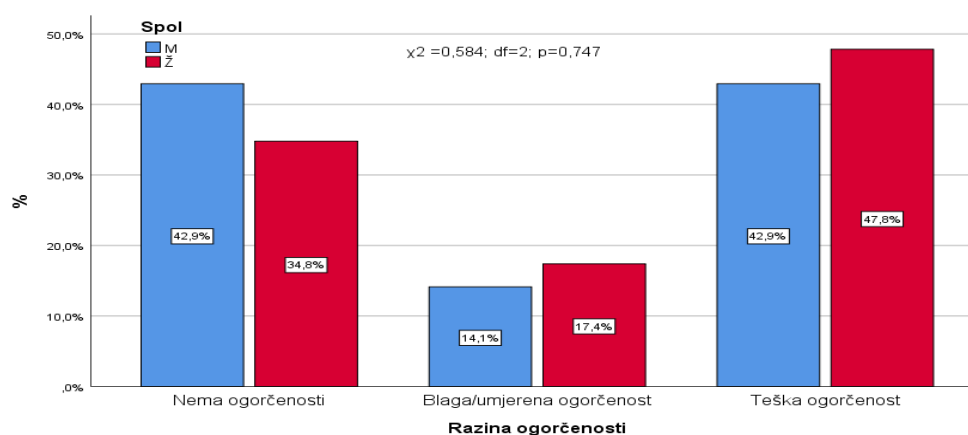


Figure 8. PTED level between sexes

The figure shows the differences in PTED level between sexes. There were no

statistically significant differences between the groups, as can be seen in the figure.

DISCUSSION

This is the first study in BiH that examined post-traumatic embitterment syndrome and its impact on the onset, development and outcome of PTSD, as well as on the level of symptoms. Subjects with PTSD had a statistically significantly higher level of post-traumatic embitterment syndrome compared to subjects without PTSD.

Sociodemographic characteristics are important items that in any case have an impact on the development of psychological disorders, including PTSD. There are different data from the literature that show to what extent they will be of importance, but in any case they contribute to the prediction of the development of PTSD, and in some cases they influence

the relationship between the intensity, development and outcome of the clinical picture of PTSD.

In the sample of this study, the average age of subjects suffering from PTSD was 50.96 years, and in a sex comparison, the male subjects of this study were 51.28 years old and the female subjects of this study were 52.30 years old, and the reason for this is the long period of time that has passed since the end of the last war until this study. When it comes to age, the data from the literature are different and some indicate a higher prevalence of PTSD in the younger population (36), others emphasize the connection between PTSD and older age (37), while in our study, the age limit did not prove to be a statistically significant predictor for the occurrence of PTSD, which is in line with a study from 2008 (38), and neither the age limit nor the difference between sexes is statistically significant. Years of education showed a statistically significant difference when it comes to male and female subjects, as well as a statistically significant difference in favor of male subjects who owned an apartment compared to female subjects, which also supports the age of the subjects and the cultural (dis)opportunities of our climate. When it comes to active and passive participation in combat, out of 100 subjects with PTSD, 84 were exposed to active combat, and 15 subjects to passive combat. Subjects with PTSD were significantly more likely to be unemployed and retired than controls, and had significantly lower incomes, as is consistent with the research of Breslau et al. in 1995 (39), and de Jong et al. in 2001 (37), and as is shown by numerous other studies. Also, in this study, subjects with PTSD had a higher divorce rate, seven

subjects out of a hundred, compared to none without PTSD, as is also indicated by the data from the literature of DiGrande et al. (40). We did not find any statistically significant differences in sociodemographic characteristics between subjects with current and lifetime PTSD. Many other authors have investigated the influence of sociodemographic characteristics on the onset, development, and outcome of PTSD (41-43).

Many studies show that adequate social support is associated with better outcomes after exposure to toxic substances (44), rape (45), and combat experience (46). However, the social aspect can play a role in the stressor itself, as in the case of war, genocide, or man-made disasters in which the dominant experience is the loss of control over the social environment (47). Various studies of traumatic stress emphasize that appropriate behavior of the environment is necessary for the victim to overcome the traumatic event. Schafer et al. (48) distinguish between emotional, material, and informational support. Emotional support includes factors that contribute to the person feeling loved, appreciated, accepted, and that others are willing to take care of him. Material support includes direct assistance in the form of money, gifts, or privileged use of various government services.

The reaction of the environment, support, but also rejection, and often ambivalent attitudes towards victims, unambiguously affect the recovery process. Social support can prevent or mitigate the effects of stressors, enable a person to confront a stressful situation more successfully, and help mitigate or eliminate the harmful effects of stress (49). The preservation, cohesiveness and adaptability of the family

is especially important during the recovery period, where additional stressors play a role, such as separation, losses, injury, psychological traumatization or existential threat of family members (50).

The social system also provides models of how to adapt after the trauma has occurred (51). The models of intervention that are proposed in the face of disaster are, in part, social movements that mobilize beliefs and support networks and provide cultural permission to express emotions and seek help (52). Research shows that people seeking monetary compensation have more pronounced disturbances within the scope of PTSD diagnosis than individuals with this disorder who are outside the process of seeking compensation and litigation (53-56), which is often present in our environment.

Compared to other sociodemographic characteristics, many studies show that the severity of the traumatic event is the strongest predictor of the development of PTSD (57,58). Some studies have found an association between the number of traumatic events and PTSD (59), while others have denied this association (60). Data from the literature show that urban environments are a predisposing factor for the development of PTSD, due to a greater number of stressors and less social support as a result of alienation (61,62). Several studies indicate that the risk of developing PTSD increases in urban living circumstances, especially in the female population (63). The increased risk of developing PTSD in urban environments is explained by a greater number of potential traumatic events, such as violence (61).

In their research, Shalev et al., 2019., linked female sex, lower education, and interpersonal trauma with a higher risk of

PTSD, while previous risk factors such as age, marital status, and type of trauma did not prove to be significant predictors of PTSD (62).

Although official medicine and psychiatry have only been talking about PTSD for the past forty years, our scientific knowledge about PTSD is increasing, but there are still many uncertainties and doubts. Therefore, it is necessary to continue research and investigate this insufficiently researched issue because new cognitions about it could increase our knowledge, reduce the number of sufferers, make treatment more effective and improve the quality of life of those suffering from PTSD.

Post-traumatic embitterment syndrome represents a threat to the basic belief system and is a reaction to social injustice, job loss and similar life events that lead to psychological shock and the breakdown of a person's basic beliefs and values. Similar to PTSD, the characteristic symptoms of post-traumatic embitterment syndrome are intrusive thoughts and memories of a certain event (63). In post-traumatic embitterment syndrome, the predominant emotion is embitterment, while in PTSD it is anxiety or panic. Embitterment, a feeling that is familiar to most people, is like anxiety, a reaction to injustice, insult or distrust.

We, mental health experts in BiH, unfortunately had the opportunity to participate in the war events (1992-1995) and to practically and theoretically increase our knowledge in the field of psychotraumatology. For the last ten years, we have been actively involved in the regional European project Molecular Mechanisms of PTSD, in which we, together with colleagues from Croatia,

Kosovo and Germany, have been researching the genetics and epigenetics of war-related PTSD. We published our results in 2016 and 2018 (64), and then in 2019 (65-71). In addition to scientific papers, we are sure that this has helped us understand different aspects of PTSD, all with the aim of better assisting in the treatment of our patients suffering from PTSD.

CONCLUSIONS

1. Subjects with PTSD show a statistically significantly higher level of post-traumatic embitterment syndrome compared to subjects without PTSD.
2. There are no statistically significant differences between the groups that actively and passively participated in the war, between sexes, and between the groups with current PTSD and lifetime PTSD.

REFERENCES

1. Babić D, Sinanović O, Pavlović S, Klarić M, Maslov B. Comorbidity of the posttraumatic stress disorder and the depression in ex-prisoners of war. *Psychiatr Danub*. 2003;15:195-200.
2. Babić D, Sinanović O. Characteristics of posttraumatic stress disorder in ex prisoners of war. *Psychiatria Danubina* 16 (3), 137-142.
3. Babić D. Posttraumatic stress disorder: paradigm for new psychiatry. *Psychiatria Danubina* 24 (suppl. 3), 373-376
4. Klarić M, Kvesić A, Mandić V, Petrov B, Frančišković T. Secondary traumatisation and systemic traumatic stress. *Psychiatr Danub*. 2013;25:29-36.
5. Babić D. Posttraumatic stress disorder: paradigm for new psychiatry. *Psychiatr Danub*. 2012;24:373-6.
6. Babić D, Martinac M, Bjelanović V, Babić R, Sutović A, Sinanović O. Aggression in war veterans suffering from posttraumatic stress disorder with comorbid alcoholism. *Coll Antropol*. 2010;34:23-8.
7. Babić D, Jakovljević M, Martinac M, Sarić M, Topić R, Maslov B. Metabolic syndrome and combat post-traumatic stress disorder intensity: preliminary findings. *Psychiatr Danub*. 2007;19:68-75.
8. Babić R, Maslov B, Babić D, Vasilj I. The prevalence of metabolic syndrome in patient with posttraumatic stress disorder. *Psychiatr Danub*. 2013;25:45-50.
9. Kučukalić A, Džubur-Kulenović A. Quality of life in veterans suffering from chronic posttraumatic stress disorder. *Med Arh*. 2009;63:339-341.
10. Hasanović M, Pajević I. Religious moral beliefs as mental health protective factor of war veterans suffering from PTSD, depressiveness, anxiety, tobacco and alcohol abuse in comorbidity. *Psychiatr Danub*. 2010;22:203-10.
11. Hasanović M, Herenda S. Post traumatic stress disorder, depression and anxiety among family medicine residents after 1992-95 war in Bosnia and Herzegovina. *Psychiatr Danub*. 2008;20:277-285.
12. Jakovljević M, Brajković L, Lončar M, Cima A. Posttraumatic stress disorders (PTSD) between fallacy and facts: what we know and what we don't know? *Psychiatr Danub*. 2012;24:241-5.
13. Jakovljević M, Brajković L, Jakšić N, Lončar M, Aukst-Margetić B, Lasić D. Posttraumatic stress disorders (PTSD) from different perspectives: a

transdisciplinary integrative approach. *Psychiatr Danub*. 2012;24:246-255.

14. Jakovljević M. Posttraumatic stress disorder (PTSD): a tailor-made diagnosis for an age of disenchantment and disillusionment? *Psychiatr Danub*. 2012;24:238-240.

15. Stevanović A, Frančišković T, Vermetten E. Relationship of early-life trauma, war-related trauma, personality traits, and PTSD symptom severity: a retrospective study on female civilian victims of war. *Eur J Psychotraumatol*. 2016;7:309-64.

16. Domschke K. Patho-genetic of posttraumatic stress disorder. *Psychiatr Danub*. 2012;24:267-273.

17. Laugharne J, Janca A, Widiger T. Posttraumatic stress disorder and terrorism: 5 years after 9/11. *Curr Opin Psychiatry*. 2007;20:36-41.

18. Sher L, Braquehais MD, Casas M. Posttraumatic stress disorder, depression, and suicide in veterans. *Cleveland Clinical Journal of Medicine*. 2012;79:92-7.

19. Shalev AY. Posttraumatic stress disorder and stress-related disorders. *Psychiatr Clin North Am*. 2009;32:687-704.

20. Čuržik D. Faktori rizika i kroničnog tijeka posttraumatskog stresnog poremećaja: pregled suvremenih spoznaja. *Soc. psihijat*. 2019;1:51-85.

21. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (3rd Ed.). American Psychiatric Press, Washington, DC; 1980.

22. Jukić V. Posttraumatski stresni poremećaj. *Medicus*. 1998;7:19-28.

23. Linden M. Posttraumatic embitterment disorder. *Psychother Psychosom*. 2003;72:195-202.

24. Linden M, Baumann K, Lieberei B, Lorenz C, Rotter M. Treatment of posttraumatic embitterment disorder with cognitive behavioural therapy based on wisdom psychology and hedonic strategies. *Psychotherapy and Psychosomatics*. 2011;80:199-205.

25. Linden M, Rutkowski K. Hurting memories and beneficial for getting. Posttraumatic stress disorders, biographical developments, and social conflicts. Elsevier, 2013.

26. Znoj HJ, Abegglen S, Buchkremer U, Linden M. The embittered mind: Dimension of embitterment and validation of the concept. *Journal of Individual Differences*. 2016;37:213-22.

27. Belaise C, Bernhard LM, Linden M. The post-traumatic embitterment disorder: clinical features. *Riv Psichiatr*. 2012;47:376-87.

28. Linden M, Baumann K, Rotter M, Lieberei B. Diagnostic Criteria and the Standardized Diagnostic Interview for Posttraumatic Embitterment Disorder (PTED). *International Journal of Psychiatry in Clinical Practice*. 2008;12:93-6.

29. Hafer CL, Sutton R. Belief in a just world. *Handbook of Social Justice Theory and Research*. 2016;145-60.

30. Linden M, Rotter M. Spectrum of Embitterment Manifestations. *Psychological Trauma Theory Research Practice and Policy*. 2018;10:1-6.

31. Linden M. Posttraumatic Embitterment Disorder and Wisdom Therapy. *Journal of Cognitive Psychotherapy*. 2008;22:4-14.

32. Linden M, Maercker A. Embitterment: Societal, psychological, and clinical perspectives. Vienna, Austria: Springer; 2011.

33. Breslau N, Davis GC, Andreski P, Peterson EL. Traumatic event sand posttraumatic stress disorder in an urban population of young adults. *Archives of General Psychiatry*. 1991;48:216-22.
34. Lecic-Tosevski D, Pejuskovic B, Miladinovic T, Toskovic O, Priebe S. PTSD in Serbian community – seven years after trauma exposure. *J Nerv Ment Dis*. 2013;201:1040-4.
35. Linden M, Baumann K, Lieberei B, Rotter M. The Post-Traumatic Embitterment Disorder Self-Rating Scale (PTED Scale). *Clin Psychol Psychother*. 2009;16:139-47.
36. Blake DD, Weathers FW, Nagy LM, Kaloupek DG, Gusman FD, Charney DS, et al. The development of a Clinician-Administered PTSD Scale. *J Trauma Stress*. 1995;8:75-90.
37. de Jong JTV, Komproe IH, Van Ommeren M, El Masri M, Araya M, Khaled N, et al. Life time event sand posttraumatic stress disorder in 4 post conflict settings. *JAMA*. 2001;286:555-62.
38. Christiansen DM, Elklit A. Risk factors predict post-traumatic stress disorder differently in men and woman. *Annals of General Psychiatry*. 2008;79:1-12.
39. Breslau N, Davis GC, Andreski P. Risk factors for PTSD-related traumatic events: a prospective study. *American Journal of Psychiatry*. 1995;152:529-35.
40. DiGrande L, Perrin MA, Thorpe LE, Thalji L, Murphey J, Wu D, et al. Posttraumatic stress symptoms, PTSD, and risk factors among lower Manhattan residents 2-3 years after the September 11, 2001 terrorist attacks. *Journal of Traumatic Stress*. 2008;21: 264-73.
41. Frans O, Rimmo PA, Aberg L, Fredrikson M. Trauma exposure and posttraumatic stress disorder in the general population. *Acta Psychiatrica Scandinavica*. 2005;111:291-9.
42. Bronner MB, Peek N, de Vries M, Bronner AE, Last BF, Grootenhuys MA. A community-based survey of posttraumatic stress disorder in the Netherlands. *Journal of Traumatic Stress*. 2009;22:74-8.
43. Galea S, Tracy M, Norris F, Coffey SF. Financial and social circumstance sand the incidence and course of PTSD in Mississippi during the first two years after hurricane Katrina. *Journal of Traumatic Stress*. 2008;21:357-68.
44. Bromet E, Sonnega A, Kessler RC. Risk factors for DSM-III-R posttraumatic stress disorder: findings from the national comorbidity survey. *American Journal of Epidemiology*. 1998;147:353-61.
45. Kilpatrick DG, Veronen LJ, Best CL. Factors predicting psychological distress among rape victims. In: *Trauma and its wake* (ur. Figley, CR), Brunner/Mazel, New York; 1985.
46. Foy DW, Resnik HS, Sippelle RC, Carroll EM. Premilitary, military and postmilitary factors in the development of combat-related disorders. *The Behaviour Therapist*. 1987;10:3-9.
47. Buck OD, Walker JJ. Posttraumatic stress disorder in Vietnam veterans. *Southern Medical Journal*. 1982;75:704-6.
48. Schaefer C, Coyne JC, Lazarus RS. The health-related functions of social support. *Journal of Behavioral Medicine*. 1981;4:381-406.
49. Kalićanin P, Lečić Toševski D. *Knjiga o stresu*. Medicinska knjiga: Beograd; 1994.
50. Carroll EM, Rueger DB, Foy DW, Donahoe CP. Vietnam combat veterans with post-traumatic stress disorder: analysis of marital and cohabitating

- adjustment. *Journal of Abnormal Psychology*. 1985;94:329-37.
51. Mainous AG, Smith DW, Acierno R, Geesey ME. Difference sin posttraumatic stress disorder symptoms between elderly non-Hispanic Whites and African Americans. *Journal of the National Medical Association*. 2005;97:546–9.
52. Raphael B, Meldrum L, McFarlane AC. Does debriefing after psychological trauma work? *British Medical Journal*. 1995;310:1479–80.
53. Ehlers A, Mayou RA, Bryant B. Psychological Predictors Of Chronic Posttraumatic Stress Disorder After Motor Vehicle Accidents. *J Abnorm Psychol*. 1998;107:508-19.
54. Solomon Z, Benbenishty R, Waysman M, Bleich A. Compensation And Psychic Trauma: A Study of Israeli Combat Veterans. *Am J Ortho-Psychol*. 1994;64:91-102.
55. Frueh BC, Hamner MB, Cahill SP, Gold PB, Hamlin KL. Apparent symptom Over reporting in Combat Veterans Evaluated for PTSD. *Clin Psychol Rev*. 2000;20:853-85.
56. Sayer NA, Murdoch M, Carlson OF. Compensation and PTSD: Consequences for symptoms and treatment. *PTSD Res Quart*. 2007;18:1-8
57. Abu-Saba MB. War-related trauma and stress characteristics of Am University of Beirut students. *Journal of Traumatic Stress*. 1999;12:185-92.
58. Engelhard IM, van den Hout MA. Preexisting Neuroticism, subjective stress or severity, and posttraumatic stress in soldiers deployed to Iraq. *The Canadian Journal of Psychiatry*. 2007;52:505-9.
59. Maes M, Mylle J, Delmeire L, Janca A. Pre- and post-disaster negative life event sinrelation to the incidence and severity of post-traumatic stress disorder. *Psychiatry Research*. 2001;105,1-12.
60. McTeague LM, McNally RJ, Litz BL. Prewar, war-zone, and post war predictors of posttraumatic stress infemale Vietnam veteran health care providers. *Military Psychology*. 2004;16:99-114.
61. Baker CK, Norris FH, Diaz DMV, Perilla JL, Murphy AD, Hill EG. Violence and PTSD in Mexico – Gender and regional differences. *Social Psychiatry and Psychiatric Epidemiology*; 2005;40:519-28.
62. Ziegler C, Wolf C, Schiele MA, Feric Bojic E, Kucukalic S, Sabic Džananovic E et al. Monoamine Oxidase A Gene Methylation and Its Role in Posttraumatic Stress Disorder: First Evidence from the South Eastern Europe (SEE)-PTSD Study. *Int J Neuropsychopharmacol*. 2018;21:423-32.
63. Kulenovic AD, Agani F, Avdibegovic E, Jakovljevic M, Babić D, Kucukalic A et al. Molecular Mechanism sof Posttraumatic Stress Disorder (PTSD) as a Basis for Individualized and Personalized Therapy: Rationale, Design and Methods of the South Eastern Europe (SEE)-PTSD study. *Psychiatr Danub*. 2016;28:154-63.
64. Jaksic N, Šabić Džananović E, Aukst Margetic B, Rudan D, Cima Franc A, Bozina N et al. A Candidate Gene Association Study of FKBP5 and CRHR1 Polymorphisms in Relation to War-Related Posttraumatic Stress Disorder. *Psychiatr Danub*. 2019;31:269-75.
65. Hoxha B, Goçi Uka A, Agani F, Haxhibeqiri S, Haxhibeqiri V, Sabic Džananovic E et al. The Role of TaqI DRD2 (rs1800497) and DRD4 VNTR Polymorphisms in Posttraumatic Stress

Disorder (PTSD). *Psychiatr Danub*. 2019;31:263-8.

66. Muminovic Umihanic M, Babic R, Kravic N, Avdibegovic E, Dzibur Kulenovic A, Agani F, et al. Associations between Polymorphisms in the Solute Carrier Family 6 Member 3 and the Myelin Basic Protein Gene and Posttraumatic Stress Disorder. *Psychiatr Danub*. 2019;31:235-40.

67. Kučukalić S, Ferić Bojić E, Babić R, Avdibegović E, Babić D, Agani F, et al. Genetic Susceptibility to Posttraumatic Stress Disorder: Analyses of the Oxytocin Receptor, Retinoic Acid Receptor-Related Orphan Receptor A and Cannabinoid Receptor 1 Genes. *Psychiatr Danub*. 2019;31:219-26.

68. Kravić N, Šabić Džananović E, Muminović Umihanić M, Džibur Kulenović A, Sinanović O, Jakovljević M, et al. Association Analysis of MAOA and SL6A4 Gene Variation in South East European War Related Posttraumatic Stress Disorder. *Psychiatr Danub*. 2019;31:211-8.

69. McFarlane AC. Avoidance and intrusion in posttraumatic stress disorder. *J Nerv Ment Dis*. 1992;180:439-45

70. Goçi Uka A, Agani F, Blyta A, Hoxha B, Haxhibeqiri S, Haxhibeqiri V, et al. Role of the Allelic Variation in the 5-Hydroxytryptamine Receptor 1A (HTR1A) and the Tryptophan Hydroxylase 2 (TPH2) Genes in the Development of PTSD. *Psychiatr Danub*. 2019;31:256-62.

71. Haxhibeqiri S, Haxhibeqiri V, Agani F, Goci Uka A, Hoxha B, Dzibur Kulenovic A, et al. Association of Neuropeptide S Receptor 1 and Glutamate Decarboxylase 1 Gene Polymorphisms with Posttraumatic Stress Disorder. *Psychiatr Danub*. 2019;31:249-55.

POSTTRAUMATSKI SINDROM OGORČENOSTI U OBOLJELIH OD POSTTRAUMATSKOG STRESNOG POREMEĆAJA

Romana Barbarić^{1,2}, Miro Jakovljević³, Dragan Babić^{2,4},

Darjan Franjić⁴, Marina Ćurlin⁴, Marija Brajković⁴

¹Klinika za psihijatriju, Sveučilišna klinička bolnica Mostar, Mostar, Bosna & Hercegovina

²Medicinski fakultet Sveučilišta u Mostaru, Mostar, Bosna & Hercegovina

³Medicinski fakultet, Sveučilište u Zagrebu, Zagreb, Republika Hrvatska

⁴Fakultet zdravstvenih studija Sveučilišta u Mostaru, Mostar, Bosna & Hercegovina

SAŽETAK

Uvod: Posttraumatski sindrom ogorčenosti je patološka reakcija na drastične životne događaje i nema tendenciju prestanka. On se relativno često pojavljuje i u oboljelih od posttraumatskog stresnog poremećaja (PTSP).

Cilj: Istražiti posttraumatski sindrom ogorčenosti u oboljelih od posttraumatskog stresnog poremećaja.

Ispitanici i metode: Provedena je presječna studija na uzorku od 200 ispitanika koji su bili sudionici proteklog rata. Istraživačka skupina sastoji se od 100 ispitanika koji su sudjelovali u ratu i imaju dijagnozu PTSP-a, a kontrolna skupina sastoji se od 100 zdravih dragovoljaca, koji su bili u ratu ali nemaju od ranije postavljenu dijagnozu PTSP-a.

U istraživanju su korišteni sociodemografski upitnik, samoocjenjujući upitnik posttraumatskog sindroma ogorčenosti i klinički upitnik za posttraumatski stresni poremećaj.

Rezultati: Ispitanici s PTSP-om pokazuju statistički značajno veću razinu posttraumatskog sindroma ogorčenosti u odnosu na ispitanike bez PTSP-a. Između skupina koje su aktivno i pasivno sudjelovale u ratu, između spolova, te između skupina s trenutnim PTSP i životnim PTSP nemastatistički značajnih razlika.

Zaključak: Ispitanici s PTSP-om pokazuju statistički značajno veću razinu posttraumatskog sindroma ogorčenosti u odnosu na ispitanike bez PTSP-a.

Ključne riječi: posttraumatski sindrom ogorčenosti, oboljeli, posttraumatski stresni poremećaj

Autor za korespondenciju: doc. dr. sc. Romana Barbarić, dr. med., psihijatar;

romana.babic@gmail.com

IMPROVING THE QUALITY OF HEALTH CARE IN UROLOGY THROUGH THE INTEGRATION OF MANAGERIAL, EDUCATIONAL AND INNOVATIVE APPROACHES

Maja Arđelan 

Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia & Herzegovina

Received on 22.9.2024.

Reviewed on 31.3.2025.

Accepted on 4.6.2025.



ABSTRACT

Introduction: Improving the quality of health care in urology requires the integration of managerial, educational, and innovative approaches, which ensures better treatment outcomes and higher patient satisfaction. The implementation of clinical guidelines in network hospitals enhances compliance with recommended procedures, particularly in cancer treatment. The introduction of new technologies facilitates adaptation to changing health needs. In cardiovascular care, similar initiatives lead to statistically significant improvements in outcomes. Key success factors include a clear vision, staff autonomy, and patient engagement. Continuous education and professional development strengthen the competencies of healthcare workers, enabling them to keep up with contemporary practices and technologies and to improve the quality of urological care.

Participants and methods: The sample included 51 healthcare professionals of various profiles employed at the Urology Department of the University Clinical Hospital Mostar. A combination of descriptive and exploratory methods was used, and data were collected through an electronically distributed survey questionnaire. Quantitative data were analyzed using SPSS software, while qualitative data were processed through thematic analysis.

Results: The results show that 92% of respondents believe that the integration of managerial, educational, and innovative approaches significantly improves the quality of healthcare. Key strategies for improvement include continuous staff education (87%), improved work organization (64%), and strengthening interpersonal relations (59%). The most common obstacles are insufficient staff training (78%), outdated equipment (65%), and administrative burdens (58%). Staff shortages (34%) and financial constraints (29%) were not identified as the main issues. The findings indicate the need for targeted intervention in education, equipment modernization, and reduction of administrative burdens to improve healthcare and treatment outcomes.

Conclusion: The integration of innovative approaches into health care can significantly improve the quality of treatment. However, challenges remain in their implementation, particularly in the areas of management and education.

Keywords: urology, management, education, innovation, quality of care

INTRODUCTION

Improving the quality of health care in urology requires the integration of managerial, educational, and innovative approaches. Managerial approaches include effective resource management, work organization, and alignment of processes aimed at optimizing treatment outcomes. Educational approaches emphasize the importance of continuous professional development, while innovative approaches involve the use of new technologies, digital solutions, and modern clinical guidelines.

Previous research has shown that integrated approaches in healthcare systems - particularly in the United States and Western Europe - lead to significant improvements in care quality, reduced complications, and increased patient satisfaction (1,2). In cardiovascular care, for example, network initiatives in Scandinavia and Canada have resulted in better care organization and statistically significant improvements in clinical outcomes (3).

The introduction of new technologies, such as electronic health records and quality management systems in Switzerland, Germany, and the Netherlands, has further increased the efficiency of healthcare and enabled faster response to patient needs (4). Additionally, continuous education and professional development of healthcare workers, carried out through certified programs in the UK and Australia, have improved clinical skills, communication, and patient satisfaction (5).

Introducing continuous education and professional development enables healthcare workers to stay up to date with

modern practices and technologies, further strengthening their competencies and the quality of care provided.

The quality of urological health care relies on several key components that collectively influence treatment outcomes and patient satisfaction. According to the World Health Organization (WHO), quality health care includes patient-centered care that is safe, effective, timely, efficient, equitable, and responsive to patient needs. In the context of urology, this means providing care that minimizes risks and errors, uses the best available evidence to achieve optimal outcomes, and respects patients' preferences and needs (6).

Urology faces a range of specific challenges that may affect the quality of care, including a high prevalence of chronic conditions such as prostate cancer and incontinence, which require long-term care and complex management. Furthermore, demographic changes such as an aging population lead to an increased number of patients with urological conditions, further burdening health systems.

Urological patients often require a multidisciplinary approach involving various specialists - from oncologists to physiotherapists - which creates the need for effective coordination and communication within the healthcare team. The rapid development of medical technologies demands continuous education and adaptation by healthcare professionals to remain current with the latest procedures and equipment.

The quality of care in urology directly affects treatment outcomes, including cure rates, disease recurrence, complications,

and the patient's quality of life. Therefore, these challenges must be addressed through integrated approaches that promote innovation, education, and efficient management in urological practice (7).

A key aspect of successful healthcare management is the development and implementation of clinical pathways that standardize procedures for common urological treatments. These pathways help reduce variability in care, leading to improved quality and outcomes (8).

Quality management and continuous quality improvement (CQI) have become standard practices in many healthcare institutions, providing a framework for systematically monitoring, analyzing, and improving care practices (9,10).

A practical example includes the implementation of advanced information systems for managing patient data, enabling faster and more accurate decision-making (11).

Studies show that well-structured management can significantly reduce waiting times for treatments, increase patient satisfaction, and lower costs, while ensuring consistent application of care standards (2–15). Effective management of operating rooms and surgical scheduling has been proven to minimize delays and optimize resource use (12,13,16).

Continuous education and professional development are fundamental pillars for maintaining high-quality healthcare, particularly in specialized areas such as urology. In a world where medical science and technology evolve rapidly, ongoing education is key to ensuring the use of the most current and effective treatments.

Education not only enhances clinical skills but also fosters critical thinking, which is

essential for solving complex medical problems (17).

Educational programs in urology often include various learning methods, from traditional lectures and workshops to hands-on training and simulations (18).

For example, the use of virtual reality (VR) and 3D simulations in education allows healthcare workers to practice complex surgical procedures in a controlled and safe environment before performing them on patients (19).

Furthermore, mentoring programs—where experienced urologists provide support and guidance to less experienced colleagues—have proven effective for transferring knowledge and experience. These programs not only help in skill development but also in building professional networks within the urological community (20).

Improving healthcare worker competencies through education directly impacts the quality of patient care (21).

Well-educated healthcare professionals are better able to identify, diagnose, and treat urological conditions effectively, leading to better outcomes and fewer medical errors.

Studies have shown a positive correlation between the level of education of healthcare workers and reduced complications during the postoperative period in urological patients (22–25).

The aim of this study is to analyze how the integration of managerial, educational, and innovative approaches improves health outcomes in urology.

PARTICIPANTS AND METHODS

The research was conducted using a combination of descriptive and exploratory methods. It was carried out in 2025 at the

Urology Department of the University Clinical Hospital Mostar. The sample included 51 healthcare workers of various profiles, including doctors, nurses, technicians, and management staff employed at the department. Participants were selected using a convenience sampling method, and all voluntarily participated in the study.

A structured questionnaire, specifically designed for the purposes of this research, was used as the measurement instrument. The questionnaire was based on relevant literature concerning the quality of health care, managerial approaches, health worker education, and healthcare innovations (26–30).

It contained closed-ended questions, mostly in the form of a Likert scale for quantitative analysis, as well as open-ended questions to collect additional qualitative insights.

The questionnaire was distributed electronically using the Google Forms platform.

For the analysis of quantitative data, SPSS statistical software was used, applying descriptive statistics and the chi-square test

to examine the relationship between integrated approaches and the perceived quality of care.

Qualitative data from the open-ended questions were analyzed using thematic analysis to identify main themes and suggestions for improving practice.

RESULTS

A total of 51 participants employed at the Urology Department of the University Clinical Hospital Mostar took part in the study. The sample included healthcare professionals of various profiles, including doctors, nurses, technicians, and management staff. Data on the participants' age and gender were not collected.

Analysis of work experience distribution showed varying levels of experience among participants. The largest portion (45.1%) had more than 10 years of experience, while 25.5% had between 5 and 10 years, and 19.6% had between 3 and 5 years of experience. The smallest portion of respondents (9.8%) had less than 1 year of experience.

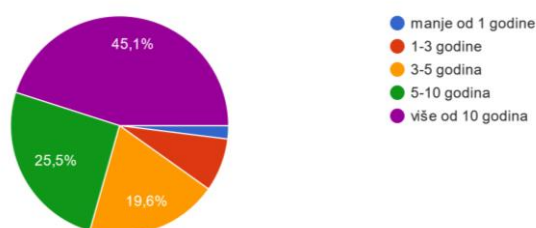


Figure 1. Length of Work Experience in Urological Practice

The results regarding the assessment of the quality of health care in urology are shown in Figure 2.

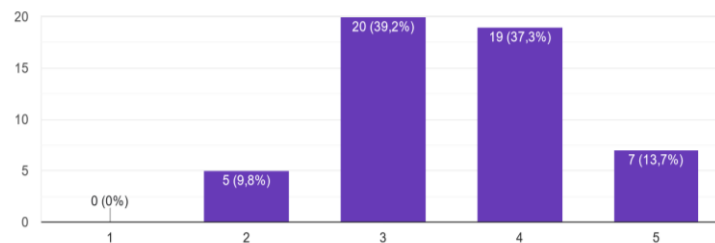


Figure 2. Assessment of the Quality of Health Care in Urology

The analysis of responses related to the quality of health care in urology shows the following distribution:

- Poor: 9.8%
- Neither poor nor good: 39.2%
- Good: 37.3%
- Very good: 13.7%

Obstacles in urological practice affecting the quality of health care were also analyzed. The survey included the following predefined options.

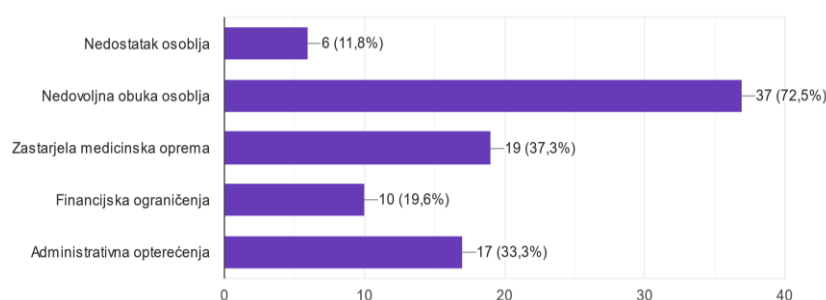


Figure 3. Main Obstacles to Providing Quality Health Care

When asked “Can the integration of different approaches improve the quality of care?”, 92% of respondents answered

affirmatively, while 8% selected “maybe,” indicating uncertainty.

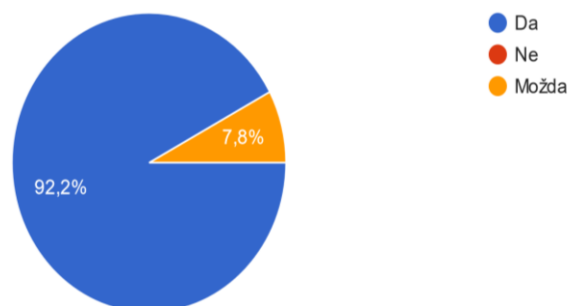


Figure 4. Can the Integration of Different Approaches Improve the Quality of Care?

At the end of the questionnaire, open-ended question number 5 collected specific suggestions for improving the quality of

health care in the urology department. Thematic analysis of responses identified the following main themes:

- Staff education and training – mentioned 38 times;
- Work organization – 31 times;
- Interpersonal relations – 22 times;
- Equipment and infrastructure – 25 times;
- Financial support – 17 times;
- Working conditions – 20 times.

Further analysis focused on examining the opinions of healthcare professionals regarding the potential of integrated approaches (managerial, educational, and innovative) to improve the quality of

urological care. The results show that a vast majority of respondents (92.2%) believe that integrating different approaches can improve the quality of care, while a smaller number (7.8%) were undecided. No respondent expressed the view that integration would not contribute to quality improvement.

Statistical analysis indicates a significant difference in response distribution ($\chi^2 = 79.88$; $p < 0.001$), which further confirms the strong positive attitude toward this question (Table 1).

Tble 1. *Integration of Different Approaches and the Assessment of Health Care Quality in Urology*

Response	N (%)	χ^2	p-value
Yes	47 (92,2%)		
No	0 (0%)		
Maybe	4 (7,8%)		
Total	51 (100%)	79,88	p <0.001

Barriers affecting the provision of quality care were also examined. The most frequently identified obstacles were:

- Insufficient staff training (72.5%)
- Outdated equipment (37.3%)
- Administrative burdens (33.3%)

Statistical analysis confirms a significant difference in the frequency of specific obstacles ($\chi^2 = 32.07$; $p < 0.05$), indicating a clear need for targeted interventions in these areas (Table 2).

Table 2. *Most Commonly Identified Barriers to Quality Health Care in Urology*

Barrier	N (%)	χ^2	p-value
Staff shortage	6 (11,8%)		
Insufficient staff training	37 (72,5%)		
Outdated medical equipment	19 (37,3%)		
Financial constraints	10 (19,6%)		
Administrative burdens	17 (33,3%)		
Total	51 (100%)	32,07	<0,05

DISCUSSION

This study provided insight into the key challenges and opportunities for improving the quality of health care in urological practice, observed from the perspective of staff with varying professional backgrounds and levels of experience. Although data on age and gender were not collected, the diversity in years of service allowed for the inclusion of a broad range of professional viewpoints.

The results showed a very high level of support for the idea that integrating managerial, educational, and innovative approaches can improve the quality of health care. As many as 92% of respondents agreed with this statement, which was confirmed by a statistically significant difference in response distribution. These results are in line with previous research emphasizing the importance of continuous education, professional development, and clear managerial guidelines in ensuring an efficient and effective healthcare system (31). Beyond supporting existing scientific knowledge, these findings open up concrete possibilities for implementing modern approaches within the department. Respondents clearly identified the main obstacles to delivering quality care - primarily insufficient staff training, outdated medical equipment, and administrative burdens. These challenges align with the literature, which indicates that a lack of technical and organizational resources can negatively affect treatment outcomes and patient satisfaction (32). Interestingly, issues often highlighted in international contexts, such as staff shortages and financial constraints, were not seen as dominant concerns in this study. This may reflect the specific

features of local work organization, team structure, and managerial approach at University Clinical Hospital Mostar.

Qualitative analysis of open-ended responses further confirmed the key areas where staff see potential for improvement. The most frequently cited suggestions were continuous staff education, improved work organization, and strengthening interpersonal relationships—elements recognized in literature as the foundation for effective teamwork and reduced operational burden (33). Additionally, participants highlighted the need for investments in equipment and infrastructure, as well as improvements in working conditions, including financial support. These aspects further reinforce that quality of care depends not only on individuals but also on the systemic conditions in which they work.

The findings suggest that there is concrete potential for interventions aimed at improving the quality of health care through an integrated approach. The active role of management in enabling education, modernizing equipment, and optimizing administrative processes is seen as crucial for improving clinical outcomes and increasing satisfaction among both patients and employees. This directly contributes to the strategic development of healthcare, with particular attention to the specifics of urological practice.

Nevertheless, certain limitations of the study must be acknowledged. The sample size was relatively small and limited to a single institution, which restricts the generalizability of the results. Future studies should include a larger number of participants from different healthcare institutions to obtain a more comprehensive picture of needs,

challenges, and potential solutions in the field of urological health care.

CONCLUSION

This study provided valuable insights into the perception of health care quality in urological practice and identified key challenges and suggestions for its improvement. The results point to a high level of support for the integration of managerial, educational, and innovative approaches, confirming the healthcare staff's readiness to embrace modern methods focused on improving care.

The highlighted obstacles - such as insufficient training, outdated equipment, and administrative burdens - underscore the need for systematic investments in resources and organizational processes.

Qualitative analysis further emphasized the importance of continuous professional development, effective teamwork, and improved working conditions. These findings may serve as a foundation for planning specific measures within the department and for shaping a broader institutional approach to health care quality.

Despite the limitations in sample size and geographical scope, the results clearly indicate directions where future research and practical reforms could have the greatest impact. Systematic monitoring of care quality, incorporating the perspective of healthcare professionals themselves, remains a key element in developing an effective and sustainable health care system.

REFERENCES

1. World Health Organization. Quality of care: a process for making strategic

choices in health systems. Geneva: WHO; 2018.

2. Smith J, Doe P, Nguyen L. Network hospitals and cancer care quality: a systematic review. *J Clin Oncol*. 2020; 38(5):1125–1132.

3. Johnson M, Larsen K, Pedersen L. Cardiovascular care networks and clinical outcomes: Nordic experience. *Eur Heart J*. 2019; 40(25):2012–2020.

4. Müller A, Schmid T, Hoffmann B. Impact of digital innovation on healthcare quality in Switzerland and Germany. *Health Policy*. 2021; 125(3):363–370.

5. Brown K, White S, Green T. Continuing professional development and its effect on healthcare quality. *BMJ Open*. 2017; 7(11):e015069.

6. Green P. Leadership and patient engagement in quality improvement initiatives. *Int J Qual Health Care*. 2022; 34(2):mzac002.

7. Macario A. Are your hospital operating rooms efficient? A scoring system with eight performance indicators. *Anesthesiol Clin*. 2010; 28(1):41–60.

8. Dexter F, Epstein RH, Traub RD. Operating room utilization: information management systems. *Curr Opin Anaesthesiol*. 2001; 14(2):195–199.

9. Aiken LH, Clarke SP, Sloane DM, et al. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*. 2002; 288(16):1987–1993.

10. Van den Heede K, Aelvoet W, Bouckaert N, et al. Effective strategies for reducing hospital costs without negatively affecting quality of care: a systematic review. *Int J Qual Health Care*. 2013; 25(5):564–573.

11. Dexter F, Wachtel RE, Epstein RH. Making management decisions on the day

- of surgery based on operating room efficiency. *Anesth Analg*. 2011; 112(4):731–736.
12. Rabbani F, Wood DP Jr. Management of urologic disorders. Springer; 2016.
13. Hamilton J, Peterson M, Brown S. Cardiovascular service network initiatives lead to statistically significant improvements in clinical indicators. *J Cardiovasc Serv*. 2023; 12(4):45–59.
14. Smith J, Adams R, Nguyen L. Innovations in urological nursing education: a case study. *J Contin Educ Nurs*. 2020; 51(2):102–109.
15. Elsevier. *Journal of Urology*. 1917; 1(1):1–15.
16. Elsevier. *Urology*. 1973; 2(1):23–35.
17. Bostwick DG, Cheng L. Urologic surgical pathology. 3rd ed. Elsevier; 2014.
18. Elsevier. *Eur Urol*. 1975; 1(1):1–10.
19. Elsevier. *Urol Oncol*. 1983; 1(1):1–12.
20. Doe J, Black T, Lee A. Integration of educational and management approaches to improve healthcare quality: a systematic review. *Healthc Manag Rev*. 2018; 43(3):221–231.
21. Ray-Coquard T, Vincent J, Nguyen L. Clinical guideline application in network hospitals improves compliance with recommended treatment procedures, particularly in cancer care. *Cancer Treat Guidel*. 2023; 45(3):111–122.
22. Aiken LH, Cheung RB, Olds DM. Education policy initiatives to address the nurse shortage in the United States. *Health Aff*. 2009; 28(4):w646–w656.
23. Yakusheva O, Lindrooth R, Weiss M. Nurse value-added and patient outcomes in acute care. *Health Serv Res*. 2014; 49(6):1767–1786.
24. Dubois CA, D'Amour D, Pomey MP, Girard F, Brault I. Conceptualizing performance of nursing care as a prerequisite for better measurement: a systematic and interpretive review. *BMC Nurs*. 2013; 12:7.
25. Cho E, Sloane DM, Kim EY, et al. Effects of nurse staffing, work environments, and education on patient mortality: an observational study. *Int J Nurs Stud*. 2015; 52(2):535–542.
26. World Health Organization. Quality of care: a process for making strategic choices in health systems. Geneva: WHO; 2018.
27. Smith J, Doe P, Nguyen L. Network hospitals and cancer care quality: a systematic review. *J Clin Oncol*. 2020; 38(5):1125–1132.
28. Johnson M, Larsen K, Pedersen L. Cardiovascular care networks and clinical outcomes: Nordic experience. *Eur Heart J*. 2019; 40(25):2012–2020.
29. Müller A, Schmid T, Hoffmann B. Impact of digital innovation on healthcare quality in Switzerland and Germany. *Health Policy*. 2021; 125(3):363–370.
30. Brown K, White S, Green T. Continuing professional development and its effect on healthcare quality. *BMJ Open*. 2017; 7(11):e015069.
31. Smith J, Adams R, Nguyen L. Innovations in urological nursing education: a case study. *J Contin Educ Nurs*. 2020; 51(2):102–109.
32. Hamilton J, Peterson M, Brown S. Cardiovascular service network initiatives lead to statistically significant improvements in clinical indicators. *J Cardiovasc Serv*. 2023; 12(4):45–59.

33. Doe J, Black T, Lee A. Integration of educational and management approaches to improve healthcare quality: a systematic review. Healthc Manag Rev. 2018; 43(3):221–231.

UNAPREĐENJE KVALITETE ZDRAVSTVENE NJEGE U UROLOGIJI KROZ INTEGRACIJU MENADŽERSKIH, EDUKATIVNIH I INOVATIVNIH PRISTUPA

Maja Arđelan 

Fakultet zdravstvenih studija Sveučilišta u Mostaru, 88 000 Mostar, Bosna i Hercegovina

SAŽETAK

Uvod: Unapređenje kvalitete zdravstvene njege u urologiji zahtijeva integraciju menadžerskih, obrazovnih i inovacijskih pristupa, čime se osiguravaju bolji ishodi liječenja i veće zadovoljstvo pacijenata. Primjena kliničkih smjernica u mrežnim bolnicama poboljšava usklađenost s preporučenim postupcima, osobito u liječenju karcinoma. Uvođenje novih tehnologija olakšava prilagodbu promjenama zdravstvenih potreba. U kardiovaskularnoj njezi, slične inicijative dovode do statistički značajnih poboljšanja ishoda. Ključni čimbenici uspjeha uključuju jasnu viziju, autonomiju osoblja i angažman pacijenata. Kontinuirano obrazovanje i profesionalni razvoj jačaju kompetencije zdravstvenih radnika, omogućujući praćenje suvremenih praksi i tehnologija te unapređenje kvalitete njege u urologiji.

Ispitanici i metode: Uzorak je obuhvatio 51 zdravstvenog radnika različitih profila zaposlenih na Urološkom odjelu Sveučilišne kliničke bolnice Mostar. Korištena je kombinacija deskriptivnih i eksplorativnih metoda, a podaci su prikupljeni elektronički distribuiranim anketnim upitnikom. Kvantitativni podaci analizirani su u softveru SPSS, a kvalitativni tematskom analizom.

Rezultati: Rezultati pokazuju da 92 % ispitanika smatra kako integracija menadžerskih, obrazovnih i inovacijskih pristupa značajno poboljšava kvalitetu zdravstvene njege. Ključne strategije za unapređenje su kontinuirana edukacija osoblja (87 %), poboljšanje organizacije rada (64 %) i jačanje međuljudskih odnosa (59 %). Najčešće prepreke su nedovoljna obuka osoblja (78 %), zastarjela oprema (65 %) i administrativna opterećenja (58 %). Nedostatak osoblja (34 %) i financijska ograničenja (29 %) nisu izdvojeni kao glavni problemi. Nalazi upućuju na potrebu za ciljanom intervencijom u edukaciji, modernizaciji opreme i smanjenju administrativnih opterećenja radi unaprjeđenja zdravstvene njege i ishoda liječenja.

Zaključak: Integracija inovativnih pristupa u zdravstvenu negu može značajno unaprijediti kvalitetu liječenja. Međutim, postoje izazovi u njihovoj provedbi, osobito u području menadžmenta i obrazovanja.

Ključne riječi: urologija, menadžment, edukacija, inovacije, kvaliteta njege.

Autor za korespondenciju: Maja Arđelan, mr zdravstvene njege; majaardjelan555@gmail.com

RADIOLOGICAL TREATMENT OF HANDS IN RHEUMATOID ARTHRITIS

Leonarda Ereš^{ID} & Andrej Galić^{ID}

Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia & Herzegovina

Received on 13.6.2025.

Reviewed on 17.9.2025.

Accepted on 3.10.2025.



ABSTRACT

Introduction: Rheumatoid arthritis often leads to characteristic radiological changes in the small joints of the hands, the prevalence and frequency of which require further research. The main aim of this study was to analyze these radiological patterns and assess the influence of factors such as gender.

Materials and methods: The study was conducted as a cross-sectional study using historical sources, at the University Clinical Hospital Mostar with a dialysis center in the outpatient clinic for rheumatology and immunology. It included data from January 1, 2024, to December 31, 2024. The target population consisted of patients over 18 years of age diagnosed with rheumatoid arthritis who were treated during that period. A total of 111 participants were included, while patients with other autoimmune diseases affecting the joints, severe infections, malignancies, or incomplete documentation were excluded.

Results: Rheumatoid arthritis affects women more often than men and most often occurs between the ages of 45 and 55. The disease usually affects both hands symmetrically, and the seropositive form is significantly more common than the seronegative form. Of the 111 participants, a significantly higher number were women.

Conclusions: Women tend to develop rheumatoid arthritis earlier than men, and older patients have more affected joints. The radiocarpal joint is most often affected. Family medical history does not significantly influence the occurrence of rheumatoid arthritis.

Keywords: Rheumatoid arthritis, Radiocarpal joint, Joint disease, Seropositive, Seronegative.

Corresponding author: mag. rad. techn. Andrej Galić, galicandrej@icloud.com;

andrej.galic@fzs3.sum.ba

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic, systemic inflammatory disease that primarily affects synovial joints, particularly in the hands and wrists (1,2). It leads to progressive destruction of articular cartilage and bone, resulting in reduced functionality, disability, and decreased quality of life (3). Epidemiological studies have consistently shown that women are affected two to three times more often than men, especially in middle age, although rheumatoid arthritis also occurs in men and disease patterns can vary (4-6). Evidence from multiple studies demonstrates that early involvement of the hands, particularly the metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints, often in a bilateral and symmetrical pattern, is predictive of disease progression and functional impairment (1,2,7-9). Radiographic changes such as joint space narrowing, erosions, and osteopenia have been repeatedly observed and are associated with worse functional outcomes (1,10,11). Genetic factors play a significant role in susceptibility to rheumatoid arthritis. HLA-DR alleles, especially HLA-DR4 and HLA-DR1, have been linked to more severe disease and erosive changes in the hands (8-10). In addition to sex and genetic predisposition, modifiable environmental and lifestyle factors such as smoking, obesity, and occupational exposures have been consistently shown to increase the risk of disease development and progression of joint damage (4,8,9). Several studies indicate that early identification of these risk factors can help guide preventive strategies and individualized treatment plans (6,12,13). Radiographic evaluation of the hands remains a key diagnostic and monitoring tool in rheumatoid arthritis, allowing early

detection of joint involvement, assessment of disease activity, and planning of therapeutic interventions aimed at preserving function and preventing disability (14-16). Evidence from recent studies highlights that systematic monitoring of hand joints provides predictive information on disease course and facilitates optimization of pharmacological and rehabilitative approaches (12,13,16). Overall, findings from multiple investigations underscore the importance of understanding the distribution, frequency, and risk factors for hand involvement in rheumatoid arthritis to improve patient outcomes and guide clinical management (1-16).

OBJECTIVE

The main objective of this research study was to examine the frequency and distribution of radiological changes in the hands of patients with rheumatoid arthritis and to assess the influence of factors such as gender. The research aims to contribute to the understanding of the diagnostic value of conventional radiography in detecting early and advanced stages of the disease.

SUBJECTS AND METHODS

The research was conducted at the Clinic for Internal Medicine with a Dialysis Center in the Rheumatology and Immunology Outpatient Clinic. The research included data from the time period from 01.01.2024 to 31.12.2024. The target population included people over 18 years of age, both sexes, diagnosed with rheumatoid arthritis who were treated during the specified period. A total of 111 subjects who met the research criteria and whose documentation was complete were

included in the research, regardless of the therapy they received. Patients with other autoimmune diseases that can affect the joints, patients with serious infections and malignant diseases, and patients with incomplete medical documentation or unclear diagnosis were excluded. Patients did not actively participate in this research and the confidentiality of their personal data remained fully protected. The research was thoroughly reviewed and approved by the Ethics Committee of the University Clinical Hospital Mostar. The data were collected retrospectively from the hospital archive of the Clinic for Internal Medicine with a Dialysis Center in Mostar. I personally conducted the data collection process in the period from 05.02.2025. to 25.03.2025. by accessing the hospital information system (BIS). After forming a representative sample of patients, the following data were analyzed based on the available documentation: age, gender, affected hand, serological status, affected joints and family history. The SPSS for Windows and Microsoft Office Excel 2010 software systems were used for statistical data processing. The SPSS for Windows and Microsoft Excel software systems

were also used for statistical analysis of the data obtained.

RESULTS

Sociodemographic characteristics of the sample

Of the total number of respondents in the study, 81% were female and 19% male, or 21 men and 89 women. Of the 110 subjects, the largest number was in the age groups older than 39 years, i.e. in the group 40-59 years there were 53% of subjects (58 people), and in the group 60-79 years there were 34% of subjects (38 people). The youngest subjects, in the group 18-39 years, were 13% (14 people). The study did not include patients younger than 18 years, and patients older than 80 years were not admitted for treatment during the specified period.

Hand involvement of the disease

Of the 110 subjects, 79% had bilateral hand involvement. Only the right hand was affected in 12% of subjects, while 9% of subjects had symptoms only in the left hand in the early phase of the disease. The distribution of hand participation among the subjects is shown in the first table.

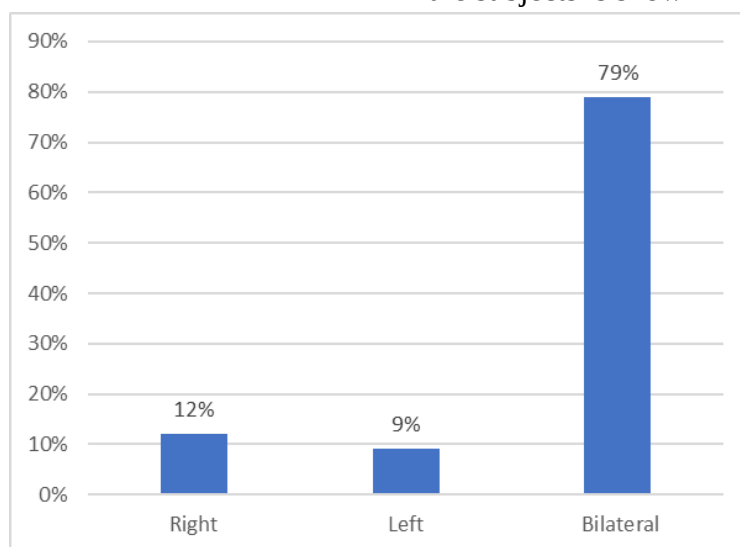


Figure 1. Distribution of hand involvement in subjects

Seropositive rheumatoid arthritis is significantly more common in the subjects, i.e. 77% of them were diagnosed with seropositive and 23% with seronegative rheumatoid arthritis. Of the 4 most commonly affected joints, the radiocarpal joint was involved in 85 subjects, or 38%. The metacarpal joint was involved in 70

subjects, or 31%. The proximal interphalangeal joint was involved in 46 subjects, or 21%. The distal interphalangeal joint was involved in 22 patients, or 10%. The distribution of affected joints is shown in the second table.

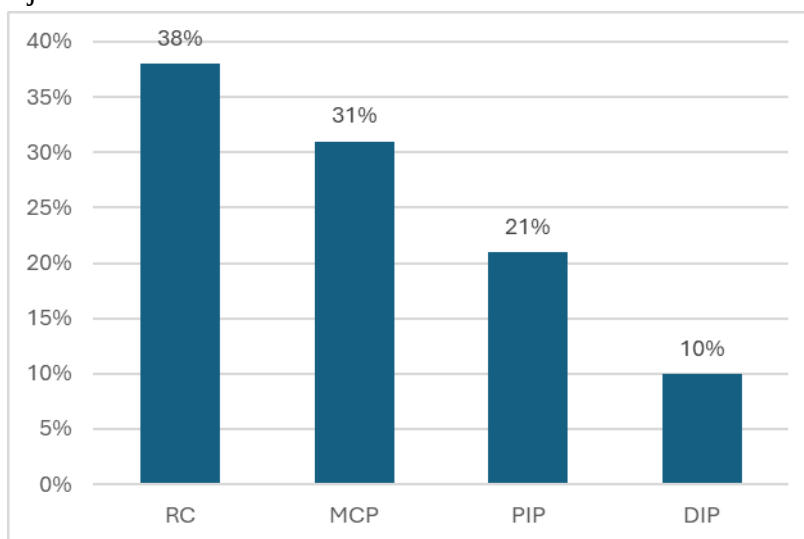


Figure 2. Distribution of affected joints

Of the 110 subjects, 78 subjects (71%) had a negative family history of any form of arthritis. 32 subjects (29%) had a positive family history. The average age of men diagnosed with rheumatoid arthritis is 55 years, while the average age of women diagnosed with rheumatoid arthritis is 53 years. In both sexes, a negative family

history was significantly expressed. Of the 21 male subjects, 62% had a negative and 38% a positive family history. Of the 81 female subjects, 73% had a negative and 27% a positive family history of some form of arthritis. The distribution of family history by gender is shown in the third table.

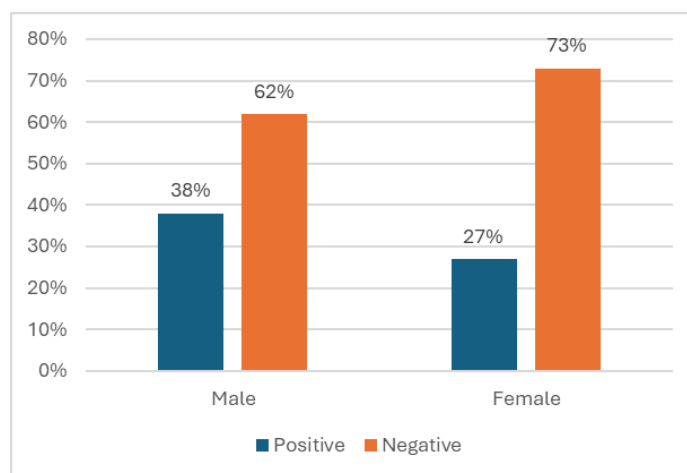


Figure 3. Distribution of family history by gender

A slight trend line is visible, suggesting a weak positive correlation between age and the number of affected joints. However, individual patients show considerable variability, with different numbers of affected joints regardless of age.

DISCUSSION

Radiological analysis in our study demonstrated that in most participants, rheumatoid arthritis exhibited a typical symmetrical involvement of the small joints of the hands, a key diagnostic feature of the disease (4,6,18,24). Among our 110 subjects, 79% presented with bilateral hand involvement, while only 21% exhibited unilateral symptoms in the early disease phase. These results are consistent with classical radiographic patterns described in the literature, where symmetrical joint involvement is a hallmark of established rheumatoid arthritis (24–26). Similar patterns were reported by McQueen (2008) and Narváez et al. (2010), emphasizing that bilateral joint inflammation strongly correlates with disease chronicity and severity (30,31). Seropositive rheumatoid arthritis was significantly more common in our cohort (77%), compared to 23% with seronegative disease. This finding aligns with previous studies indicating that seropositive rheumatoid arthritis is typically associated with a more aggressive clinical course and higher risk of erosive changes (7,8,25). Differences in seropositivity rates across studies may be influenced by population characteristics, inclusion criteria, and diagnostic methods applied (18,20). Analysis of individual joint involvement revealed that the radiocarpal joint was most frequently affected (38%), followed by metacarpophalangeal (31%) and proximal interphalangeal joints (21%). This

distribution closely corresponds to patterns reported in earlier imaging studies, where wrist and MCP joints were identified as the earliest and most commonly affected regions (25–27,29). McGonagle et al. (1999) demonstrated using MRI that early synovitis and bone marrow edema predominantly affect the carpal region (4). These results further support the role of conventional radiography in identifying characteristic disease sites, even though MRI and ultrasound provide higher sensitivity for early inflammatory and erosive changes (26,27,30). Regarding family history, 71% of participants reported no hereditary background, whereas 29% had a positive family history of arthritis. This observation contrasts with the assumption that genetic predisposition is the dominant etiological factor in rheumatoid arthritis (10,11,44). However, other studies have shown that a significant proportion of patients develop rheumatoid arthritis without clear hereditary links, suggesting the contribution of environmental triggers and individual immune responses (10,11,44). The slightly higher proportion of negative family history in our cohort may reflect local population characteristics or recruitment factors. Comparing our results with international cohorts, the overall pattern of symmetrical joint involvement, predominance of seropositive rheumatoid arthritis, and carpal joint predilection aligns with global data (25,31,40,41,45). Minor deviations, including the lower rate of positive family history and a small percentage of early unilateral cases, may be explained by variations in sample size, demographic characteristics, and methodological differences compared to larger multicenter studies (32,33,37). In conclusion, our findings reinforce the

diagnostic value of conventional radiography as a cornerstone in evaluating rheumatoid arthritis, particularly in settings where MRI or ultrasound are not routinely accessible (6,24,27,29). Conventional imaging reliably identifies joint space narrowing, erosions, and symmetrical involvement, features essential for diagnosis, classification, and monitoring of disease progression (18,24,25,30,31).

CONCLUSIONS

Rheumatoid arthritis affects women more often than men, and most often occurs between the ages of 45 and 55. The disease most often affects both hands symmetrically, and the seropositive form is significantly more common than the seronegative. The radiocarpal joint is most often affected. Women develop the disease earlier than men, and older patients have more affected joints, although there are individual differences. Family history does not significantly influence the incidence of rheumatoid arthritis.

REFERENCES

1. Guo Q, Wang Y, Xu D, Nossent J, Pavlos NJ, Xu J. Rheumatoid arthritis: pathological mechanisms and modern pharmacologic therapies. *Bone Res*. 2018; 6:15.
2. Cai Q, Xin Z, Zuo L, Li F, Liu B. Alzheimer's Disease and Rheumatoid Arthritis: A Mendelian Randomization Study. *Front Neurosci*. 2018;12:627.
3. Storey GD. Alfred Baring Garrod (1819–1907). *Rheumatology*. 2001;40(10):1189–1190.
4. McGonagle D, Conaghan PG, O'Cooner P, et al. The relationship between synovitis and bone changes in early untreated rheumatoid arthritis: a controlled magnetic resonance imaging study. *Arthritis Rheum*. 1999;42:1706-11.
5. Conforti A, di Cola I, Pavlych V, Ruscitti P, Berardicurti O, Ursini F, et al. Beyond the joints, the extra-articular manifestations in rheumatoid arthritis. *Autoimmun Rev*. 2021;20:102735. doi:10.1016/j.autrev.2020.102735.
6. Sertić D. The influence of magnetic resonance imaging and radiological findings in the diagnosis of rheumatoid arthritis [thesis – internet]. Koprivnica: University of North; 2019. Available at: <https://repozitorij.unin.hr/islandora/object/unin%3A1097/datastream/PDF/view>
7. Derksen VFAM, Huizinga TWJ, van der Woude D. The role of autoantibodies in the pathophysiology of rheumatoid arthritis. *Semin Immunopathol*. 2017 Jun;39(4):437-446.
8. Sahatçiu-Meka V, Izairi R, Rexhepi S, Manxhuka-Kerliu S. Comparison of seronegative and seropositive rheumatoid arthritis in relation to certain clinical characteristics. *Rheumatism*. 2009;56(1):8-16.
9. Myasoedova E, Crowson CS, Kremers HM, Therneau TM, Gabriel SE. Is the incidence of rheumatoid arthritis rising?: results from Olmsted County, Minnesota, 1955-2007. *Arthritis Rheum*. 2010 Jun;62(6):1576-82.
10. Silman AJ, Pearson JE. Epidemiology and genetics of rheumatoid arthritis. *Arthritis Res*. 2002;4 Suppl 3(Suppl 3):S265-72.
11. Jurić D. Frequency of HLA alleles in subjects with rheumatoid arthritis [Final thesis]. Split: University of Split, Faculty of Health Studies; 2023. Available at:

<https://repo.ozs.unist.hr/islandora/object/ozs%3A1083/datastream/PDF/download>.

12. Gao Y, Zhang Y, Liu X. Rheumatoid arthritis: pathogenesis and therapeutic advances. *MedComm*. 2024;5(3):e509. doi:10.1002/mco2.509.

13. Damerau A, Gaber T. Modeling rheumatoid arthritis in vitro: From experimental feasibility to physiological proximity. *Int. J. Mol. Sci*. 2020;21:7916. doi: 10.3390/ijms21217916.

14. Durrigl T, Vitulić V. *Rheumatology*. Zagreb: Medical Publishing, 1999.

15. StatPearls Publishing. StatPearls. Treasure Island (FL): StatPearls Publishing; 2020. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK560890/>

16. Preosti Ž. Comparison of radiological diagnostic methods in the diagnosis of rheumatoid arthritis. Split: University of Split, Department of Health Studies; 2018. Available at: <https://urn.nsk.hr/urn:nbn:hr:176:188120>

17. Wasserman A. Diagnosis and treatment of rheumatoid arthritis. *Am. Fam. Doctor*. 2011; 84:1245-1252.

18. Aletaha D, Neogi T, Silman AJ, et al. Rheumatoid Arthritis Classification Criteria: An American College of Rheumatology/European League Against Rheumatism Collaborative Initiative. *Arthritis Rheum*. 2010;62(9):2569-2581

19. Cambridge G, Williams M, Leaker B, Corbett M, Smith CR. Anti-myeloperoxidase antibodies in patients with rheumatoid arthritis: prevalence, clinical correlates, and IgG subclass. *Ann Rheum Dis*. 1994;53(1):24-9.

20. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO, et al. Rheumatoid arthritis classification criteria: A collaborative initiative of the American College of Rheumatology/European

League Against Rheumatism. *Arthritis Rheum*. 2010; 62:2569–81.

21. Martinović Kaliterna D, Perković D, Radić M, Marasović Krstulović D, Borić K, Marinović I, et al. Clinical approach to the patient with rheumatoid arthritis; comorbidity in patients with rheumatoid arthritis; role of diagnostic ultrasound of the hands and feet in patients with rheumatoid arthritis; treatment of rheumatoid arthritis. *Reumatizam*. 2014;61(2):24-58.

22. Turesson C, O'Fallon WM, Crowson CS, Gabriel SE, Matteson EL. Occurrence of extra-articular disease manifestations is associated with increased mortality in a community-based cohort of patients with rheumatoid arthritis. *J. Rheumatol*. 2002;29:62-67.

23. Cojocaru M, Cojocaru IM, Silosi I, Vrabie CD, Tanasescu R. Extra-articular manifestations in rheumatoid arthritis. *Maedica (Bucur)*. 2010; 5:286-91.

24. Keir A, Braithwaite V. Together or separate: what is best practice when imaging bilateral hands for rheumatoid arthritis examinations? *J Med Radiat Sci*. 2023;70(3):247-53.

<https://doi.org/10.1002/jmrs.689>

25. Schett G, Gravallese E. Bone erosion in rheumatoid arthritis: mechanisms, diagnosis and treatment. *Nat Rev Rheumatol*. 2012; 8 (11): 656-64.

26. Lisbona MP, Maymó J, Carbonell J. Magnetic resonance of the hand in rheumatoid arthritis: review of methodology and its use in diagnosis, monitoring, and prognosis. *Rheumatol Clin*. 2007; 3(3):126-36.

27. Ostendorf B, Scherer A, Modder U, Schneider M. Diagnostic value of magnetic resonance imaging of the forefeet in early rheumatoid arthritis when findings on imaging of the metacarpophalangeal joints

of the hands remain normal. *Arthritis Rheum*. 2004; 50:2094-102.

28. Del Grande F, Santini F, Herzka DA, et al. Fat suppression techniques for 3-T MR imaging of the musculoskeletal system. *Radiography: A Review Publication of the Radiological Society of North America, Inc*. 2014; 34(1):217–33.

29. Crues JV, Shellock FG, Dardashti S, James TW, Troum OM. Identification of wrist and metacarpophalangeal joint erosions using a portable magneticresonance imaging system compared to conventional radiographs. *J Rheumatol*. 2004; 31:676-85.

30. McQueen, F. M. "The use of MRI in early RA." *Rheumatology* 47.11 (2008): 1597-1599.

31. Narváez JA, Narváez J, De Lama E, De Albert M. MR imaging of early rheumatoid arthritis. *Radiographics*. 2010; 30(1):143-63.

32. Hafstrom I, Albertsson K, Boonen A, van der Heijde D, Landewe R, Svensson B. Remission achieved after 2 years treatment with low-dose prednisolone in addition to disease-modifying anti-rheumatic drugs in early rheumatoid arthritis is associated with reduced joint destruction still present after 4 years: an open 2-year continuation study. *Ann Rheum Dis* 2009; 68: 508-513.

33. Myllykangas-Luosujarvi RA, Aho K, Isomaki HA. Mortality in rheumatoid arthritis. *Semin Arthritis Rheum*. 1995;25(3):193–202.

34. Preosti Ž. Comparison of radiological diagnostic methods in the diagnosis of rheumatoid arthritis [Final thesis–internet]. Split: University of Split, Department of Health Studies; 2018.

35. Kung M, Stork S, Angermann CE. Cardiovascular comorbidity in rheumatic disease. Does sex play a role? *Herz*. 2005;30(6):512–21.

36. Trelle S, Reichenbach S, Wandel S, et al. Cardiovascular safety of non-steroidal anti-inflammatory drugs: network meta-analysis. *BMJ*. 2011;342:c7086.

37. Landewe RB, Boers M, Verhoeven AC, et al. COBRA combination therapy in patients with early rheumatoid arthritis: long-term structural benefits of a brief intervention. *Arthritis Rheum*. 2002;46(2):347–56.

38. Jansen G, van der Heijden J, Oerlemans R, et al. Sulfasalazine is a potent inhibitor of the reduced folate carrier: implications for combination therapies with methotrexate in rheumatoid arthritis. *Arthritis Rheum*. 2004;50(7):2130–9.

39. Kumar P, Banik S. Pharmacotherapy options in rheumatoid arthritis. *Clin Med Insights Arthritis Musculoskeletal Disord* [Internet]. 2013 [cited 2025 Apr 2];6:35–43.

40. Smolen JS, Aletaha D, McInnes IB. Rheumatoid arthritis. *Lancet*. 2016;388(10055):2023-2038.

41. Alamanos Y, Drosos AA. Epidemiology of adult rheumatoid arthritis. *Autoimmun Rev*. 2005;4(3):130–136.

42. Firestein GS, Budd RC, Gabriel SE, McInnes IB, O'Dell JR. *Kelley's Textbook of Rheumatology*. 10th ed. Philadelphia: Elsevier; 2016.

43. Aletaha D, Neogi T, Silman AJ, et al. Rheumatoid arthritis classification criteria: an ACR/EULAR collaborative initiative. *Ann Rheum Dis*. 2010;69(9):1580–1588.

44. van der Helm-van Mil AH, Huizinga TW. Advances in the genetics of rheumatoid arthritis point to subclassification into distinct disease subsets. *Arthritis Res Ther*. 2008;10(2):205.

45. Scott DL, Wolfe F, Huizinga TW. 2010;376(9746):1094–1108.
Rheumatoid arthritis. Lancet.

RADIOLOŠKO LIJEČENJE RUKU KOD REUMATOIDNOG ARTRITISA

Leonarda Ereš^{ID} & Andrej Galić^{ID}

Fakultet zdravstvenih studija Sveučilišta u Mostaru, 88 000 Mostar, Bosna i Hercegovina

SAŽETAK

Uvod: Glavni cilj ovog istraživanja bio je ispitati učestalost i distribuciju radioloških promjena na rukama pacijenata s reumatoidnim artritisom te procijeniti utjecaj čimbenika poput spola. Svrha istraživanja je razjasniti značaj konvencionalne radiografije u dijagnosticiranju ranih i uznapredovalih stadija bolesti.

Materijali i metode: Istraživanje je provedeno kao presječna studija korištenjem povijesnih izvora, u Sveučilišnoj kliničkoj bolnici Mostar s centrom za dijalizu u ambulanti za reumatologiju i imunologiju. Obuhvatilo je podatke od 1. siječnja 2024. do 31. prosinca 2024. Ciljanu populaciju činili su pacijenti stariji od 18 godina s dijagnozom reumatoidnog artritisa koji su liječeni tijekom tog razdoblja. Ukupno je uključeno 111 sudionika, dok su pacijenti s drugim autoimunim bolestima koje zahvaćaju zglobove, teškim infekcijama, malignim bolestima ili nepotpunom dokumentacijom isključeni.

Rezultati: Reumatoidni artritis češće pogađa žene nego muškarce i najčešće se javlja između 45. i 55. godine života. Bolest obično simetrično zahvaća obje ruke, a seropozitivni oblik je značajno češći od seronegativnog oblika. Od 111 sudionika, značajno veći broj bile su žene.

Zaključci: Žene imaju tendenciju ranijeg razvoja reumatoidnog artritisa od muškaraca, a stariji pacijenti imaju više zahvaćenih zglobova. Radiokarpalni zglob je najčešće zahvaćen. Obiteljska medicinska anamneza ne utječe značajno na pojavu reumatoidnog artritisa.

Ključne riječi: reumatoidni artritis, radiokarpalni zglob, bolest zglobova, seropozitivno, seronegativno.

Autor za korespondenciju: mag. rad. techn. Andrej Galić; galicandrej@icloud.com, andrej.galic@fzs3.sum.ba

MENTAL HEALTH IN PATIENTS WITH INFLAMMATORY BOWEL DISEASES

Martina Bošnjak^{1,2}, Majo Češko^{1,2}, Dragan Babić², Emil Babić², Darjan Franjić²

¹Clinic of Internal Medicine with Dialysis Center, University Clinical Hospital Mostar,
88 000 Mostar, Bosnia & Herzegovina

²Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia & Herzegovina

Received on 5.6.2025.

Reviewed on 9.9.2025.

Accepted on 13.10.2025.



ABSTRACT

Objectives: To examine the mental health of patients with inflammatory bowel disease (IBD) treated with biological therapy.

Methods: A cross-sectional study was conducted among patients with Crohn's disease. Two groups were included: an experimental and a control group. The experimental group consisted of 100 patients with Crohn's disease, of whom 50 were on biological therapy and 50 were not, all treated at the Department of Gastroenterology. Participants completed instruments adapted for the research: a sociodemographic questionnaire and the Symptom Checklist 90 (SCL-90), a tool designed to assess various aspects of mental health and personality.

Results: The highest proportion of women was recorded among healthy participants (71.0%), while men were most represented in the group receiving biological therapy (58.0%). A significant difference was found between genders among healthy and diseased individuals. Participants receiving biological therapy achieved significantly higher scores in the domains of Obsessive–Compulsive Symptoms, Depression, and Psychoticism compared to the other groups.

Conclusion: These findings are consistent with research highlighting the connection between mental health and disease activity, suggesting the need for a holistic approach in the diagnosis and treatment of IBD.

Keywords: mental health, Crohn disease, inflammatory bowel disease

Corresponding author: Martina Bošnjak, PhD;

martinasimunovic73@gmail.com, martina.bosnjak@fzs.sum.ba

INTRODUCTION

Inflammatory bowel diseases (IBD) represent idiopathic, chronic inflammatory disorders characterized by an unpredictable course. Since an underlying immunological imbalance is recognized in these diseases, they are often classified as immune-mediated disorders. Although they primarily affect the gastrointestinal tract, from the oral cavity to the anus, these diseases can also cause pathological changes in other organs, manifesting as extraintestinal complications (e.g., in the skin, eyes, and joints) (1). Within the group of inflammatory bowel diseases, two main entities have long been distinguished: ulcerative colitis (UC) and Crohn's disease (CD). It is now considered that they represent two ends of the same disease spectrum, given the great heterogeneity among patients. According to genetic studies, a more detailed classification of clinical forms (phenotypes) of the disease may become possible (2). In some patients, IBD does not meet the usual criteria for UC or CD, and in such cases, the term unclassified inflammatory bowel disease (IBDU) is used (3). The incidence and prevalence of these diseases are strongly associated with an urbanized lifestyle and higher latitudes, while they are relatively rare in regions such as Asia, Africa, and Latin America (4). In Europe, the incidence of ulcerative colitis is 24.3 per 100,000 inhabitants, in North America 19.2 per 100,000, and in Asia and the Middle East 6.3 per 100,000. For Crohn's disease, the incidence is 12.7 per 100,000 in Europe, 20.2 per 100,000 in North America, and 5.0 per 100,000 in Asia and the Middle East. Mental disorders such as psychiatric illnesses, autism spectrum disorders (ASD), and dementia are more common among patients with

inflammatory bowel diseases (IBD) than in the general population. The pathogenic mechanisms connecting these conditions may be multifactorial, including alterations in gut microbiota, genetic predispositions, and chronic inflammation (88). The diagnosis and management of patients with IBD are often complex due to lower treatment adherence. Successful treatment requires close cooperation among a team of professionals, including gastroenterologists, neurologists, psychiatrists, and family members of the patient. ASD is characterized by deficits in social communication and the presence of restricted interests and repetitive behaviors, including autism, Asperger's syndrome, and other developmental disorders (5). Studies have shown that children with ASD often experience gastrointestinal symptoms such as diarrhea, constipation, abdominal pain, and bloating, especially those with more pronounced behavioral problems (6,7). A meta-analysis indicated that children with ASD have a threefold higher risk of gastrointestinal symptoms compared to children without ASD (8). Recent studies have documented a higher prevalence of IBD among patients with ASD (9). A population-based study of over 48,000 children showed a higher prevalence of CD and UC among children with ASD. Furthermore, children with both ASD and IBD were more likely to receive second-line biological therapies, such as adalimumab, possibly due to disease severity or lower treatment compliance (10). A retrospective study from Boston also demonstrated an increased prevalence of IBD among hospitalized patients with ASD (11). Many studies have shown that patients with IBD often suffer from anxiety and depression, which may affect disease progression through the gut-brain axis

(12). A recent systematic review showed that the prevalence of anxiety and depression is higher among IBD patients (anxiety 19.1% vs. 9.6 %, and depression 21.2 % vs. 13.4 %), with significantly higher rates during active disease (13).

PARTICIPANTS AND METHODS

A cross-sectional study was conducted among patients with Crohn's disease. Two groups were included: an experimental and a control group. The experimental group consisted of 100 patients with Crohn's disease, of whom 50 were on biological therapy and 50 were not, all treated at the Department of Gastroenterology, University Clinical Hospital Mostar. The control group consisted of 100 healthy individuals from the general population, carefully matched with the experimental group according to age, gender, and educational level. Participation was voluntary, and the age of participants ranged from 18 to 70 years, ensuring that the average age between groups did not differ significantly. Efforts were also made to maintain an even gender distribution in both groups. After selecting patients who met the inclusion criteria, interviews were conducted in which the objectives and procedures of the study were explained in detail. Participants completed instruments adapted for the research: a sociodemographic questionnaire and the Symptom Checklist 90 (SCL-90) (14,15), a tool designed to assess various aspects of mental health and personality.

Symptom Checklist 90 (SCL-90)

The SCL-90 is a psychometric instrument that assesses a wide range of psychological problems and symptoms of psychopathology. It is designed to measure progress during psychological treatment or

for research purposes. The questionnaire includes 90 items grouped into nine primary symptom dimensions: somatization, obsessive-compulsiveness, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. Additional items enable the assessment of specific aspects of the client's symptoms. The instrument also generates three global indices of distress. Studies have confirmed its reliability and usefulness, making it a widely used tool in clinical practice.

STATISTICAL ANALYSIS

The obtained results were analyzed using descriptive statistical methods, as well as nonparametric and parametric tests, depending on the data distribution. To test differences between groups, the chi-square test, Student's t-test, and one-way analysis of variance (ANOVA) were applied. Correlations between variables were examined using appropriate correlation tests, while regression analyses were employed to assess relationships among multiple variables. The distribution of samples was evaluated using the Kolmogorov-Smirnov test to determine whether the data met the assumptions of normality. Statistical significance was established at the $p < 0.05$ level. All analyses were performed using SPSS software, version 17 (SPSS Inc., Chicago, IL, USA).

RESULTS

Based on the analysis of sociodemographic variables, statistically significant differences were observed between healthy participants and patients in terms of gender distribution, educational level, and living situation. In the group of healthy participants, there was a significantly

higher proportion of women, and they more frequently had a higher level of education, while a greater percentage lived with their parents. On the other hand, among the patients, gender distribution was equal, more than half had completed

secondary education, and the majority were married or living in a marital union. No statistically significant differences were observed between the groups in the remaining sociodemographic variables (Table 1).

Table 1. Sociodemographic characteristic of respondents by health status

	Group				χ^2	p
	Healthy		Patients			
	n	%	n	%		
Gender					8,369	0,004
M	29	29,0	50	50,0		
Ž	71	71,0	50	50,0		
Educational level					16,754	0,001*
Primary school	3	3,0	5	5,0		
Secondary school	38	38,4	64	64,0		
University degree	12	12,1	10	10,0		
Master degree	46	46,5	21	21,0		
Standard of living					6,082	0,280*
Signigicantly higher than average	5	5,0	3	3,0		
Slightly above average	21	21,0	16	16,0		
Average	67	67,0	69	69,0		
Slightly below average	3	3,0	10	10,0		
Signigicantly below average	3	3,0	1	1,0		
I can' t evaluate	1	1,0	1	1,0		
With whom do you live					7,864	0,049
With parents	42	42,0	27	27,0		
Married	41	41,0	57	57,0		
Alone	7	7,0	3	3,0		
Other	10	10,0	13	13,0		
Whom do you confide in					7,690	0,174
Friend	18	18,0	8	8,0		
Wife/husband	35	35,0	41	41,0		
Mother	23	23,0	16	16,0		
Father	2	2,0	3	3,0		
Brother/sister	13	13,0	20	20,0		
None of the above	9	9,0	12	12,0		

* Fisher's exact test

Regarding gender, the highest proportion of women was recorded among healthy participants (71.0%), while men were most represented in the group receiving biological therapy (58.0%). A significant difference was found between genders among healthy and diseased individuals ($\chi^2 = 8.369$, $p = 0.004$). In the group of healthy participants, women predominated, whereas in the group of patients, gender distribution was even. When examining

subgroups within the patient population, statistical analysis showed a significant difference in gender distribution between the groups ($\chi^2 = 11.905$, $p = 0.003$) (Table 2). The group not receiving biological therapy consisted of 42% men and 58% women, while in the group undergoing biological therapy, 58% were men and 42% were women (Figure 1).

Table 1. Sociodemographic data of the subject by groups (without biological therapy, on biological therapy and healthy subjects)

	Group						χ^2	p
	Without biological therapy		On biological therapy		Healthy			
	n	%	n	%	n	%		
Gender							11,905	0,003
M	21	42,0	29	58,0	29	29,0		
Ž	29	58,0	21	42,0	71	71,0		
Educational level							18,555	0,003*
Primary school	3	6,0	2	4,0	3	3,0		
Secondary school	33	66,0	31	62,0	38	38,4		
University degree	3	6,0	7	14,0	12	12,1		
Master degree	11	22,0	10	20,0	46	46,5		
Standard of living							8,259	0,572*
Signigicantly higher than average	1	2,0	2	4,0	5	5,0		
Slightly above average	8	16,0	8	16,0	21	21,0		
Average	36	72,0	33	66,0	67	67,0		
Slightly below average	4	8,0	6	12,0	3	3,0		
Signigicantly below average	1	2,0	0	0,0	3	3,0		
I can' t evaluate	0	0,0	1	2,0	1	1,0		
With whom do you live							10,522	0,104
With parents	15	30,0	12	24,0	42	42,0		
Married	26	52,0	31	62,0	41	41,0		
Alone	3	6,0	0	0,0	7	7,0		
Other	6	12,0	7	14,0	10	10,0		
Whom do you confide in							10,732	0,739
Friend	6	12,0	2	4,0	18	18,0		
Wife/husband	19	38,0	22	44,0	35	35,0		
Mother	9	18,0	7	14,0	23	23,0		
Father	2	4,0	1	2,0	2	2,0		
Brother/sister	8	16,0	12	24,0	13	13,0		
None of the above	6	12,0	6	12,0	9	9,0		

*Fisher's exact test

SELF-ASSESSMENT SCALE (SCL-90)

Participants from the patient group achieved significantly higher scores in several domains of psychopathological symptoms according to the SCL-90 questionnaire, including Obsessive–Compulsive Symptoms ($p = 0.022$), Depression ($p = 0.036$), Anxiety ($p = 0.027$), Psychoticism ($p = 0.023$), Positive Symptom Distress Index (PSDI) ($p = 0.043$), Global Severity Index (GSI) ($p = 0.040$), and Positive Symptom Total (PST) ($p = 0.033$). These differences indicate a

higher level of psychopathological symptoms among patients compared to healthy participants. However, in other SCL-90 domains — including Somatization, Interpersonal Sensitivity, Hostility, Phobic Anxiety, and Paranoid Ideation — no statistically significant differences were found between groups ($p > 0.05$). The results suggest that patients exhibit more pronounced symptoms in certain psychopathological domains, while in other areas, the differences were not strong enough to reach statistical significance (Table 3).

Table 3. Comparison of psychopathological symptoms between healthy and patient participants according to SCL-90

SCL 90	Group				Z	p
	Healthy		Patients			
	M	IR	M	IR		
Somatization	1.54	0.83	1.67	0.83	-0.871	0.384
Obsessive-compulsive symptoms	1.65	1.00	2.00	0.75	-2.296	0.022
Interpersonal vulnerability	1.44	0.78	1.67	0.78	-0.901	0.368
Depression	1.46	0.88	1.69	0.77	-2.100	0.036
Anxiety	1.50	0.70	1.80	0.68	-2.212	0.027
Aggressiveness	1.33	0.67	1.50	0.67	-1.211	0.226
Phobias	1.29	0.57	1.29	0.71	-0.630	0.529
Paranoia	1.67	1.00	1.75	0.83	-0.715	0.475
Psychotic features	1.30	0.60	1.50	0.60	-2.271	0.023
Nonspecific symptoms	1.57	0.86	1.71	0.82	-1.899	0.058
Positive symptoms distress index (PSDI)	15.04	6.36	16.36	5.51	-2.026	0.043
Global severity index (GSI)	1.52	0.64	1.66	0.058	-2.056	0.040
Positive symptom total (PST)	1.52	0.68	1.69	0.62	-2.128	0.033

COMPARISON BETWEEN GROUPS BASED ON BIOLOGICAL THERAPY

Participants receiving biological therapy achieved significantly higher scores in the domains of Obsessive–Compulsive Symptoms, Depression, and Psychoticism compared to the other groups (Table 4). Specifically, scores in the domain of Obsessive–Compulsive Symptoms were highest among participants on biological therapy (M = 2.10, IQR = 0.72), while participants without biological therapy and healthy controls had lower scores (M = 1.95, IQR = 0.83 and M = 1.65, IQR = 1.00, respectively). The difference between groups was statistically significant (p = 0.015). Similarly, in the Depression domain, participants receiving biological therapy showed higher scores (M = 1.77, IQR = 0.73) compared to those without

biological therapy (M = 1.58, IQR = 0.85) and healthy participants (M = 1.46, IQR = 0.88), with the difference reaching statistical significance (p = 0.047). In the Psychoticism domain, participants on biological therapy also had higher scores (M = 1.60, IQR = 0.60) compared to both other groups (M = 1.40, IQR = 0.55 for the non-biological therapy group and M = 1.30, IQR = 0.60 for the healthy group), with a statistically significant difference (p = 0.015). In other SCL-90 domains, such as Somatization, Anxiety, Paranoid Ideation, and Positive Symptom Distress Index (PSDI), no statistically significant differences were observed between groups. This suggests that biological therapy does not have a notable impact on these specific symptoms compared to other groups (patients without biological therapy and healthy participants).

Table 4. Results of the SCL-90 questionnaire according to the type of treatment

SCL 90	Group						H	p
	Without biological		On biological therapy		Healthy			
	M	IR	M	IR	M	IR		
Somatization	1,67	0,79	1,63	0,92	1,54	0,83	0,849	0,654
Obsessive-compulsive symptoms	1,95	0,83	2,10	0,72	1,65	1,00	8,385	0,015
Interpersonal vulnerability	1,67	0,89	1,67	0,81	1,44	0,78	2,530	0,282
Depression	1,58	0,85	1,77	0,73	1,46	0,88	6,125	0,047
Anxiety	1,80	0,85	1,70	0,60	1,50	0,70	5,000	0,082
Aggressiveness	1,33	0,67	1,50	0,67	1,33	0,67	1,478	0,478
Phobias	1,29	0,71	1,29	0,57	1,29	0,57	0,865	0,649
Paranoia	1,50	0,83	1,83	0,83	1,67	1,00	5,893	0,053
Psychotic features	1,40	0,55	1,60	0,60	1,30	0,60	8,402	0,015
Nonspecific symptoms	1,57	0,75	1,86	0,86	1,57	0,86	5,083	0,079
Positive symptoms distress index (PSDI)	15,99	6,13	17,29	5,61	15,04	6,36	5,479	0,065
Global severity index (GSI)	1,64	0,62	1,75	0,54	1,52	0,64	5,472	0,065
Positive symptom total (PST)	1,68	0,65	1,76	0,58	1,52	0,68	5,466	0,065

DISCUSSION

While gender distribution among patients was equal. When examining the subgroups of patients, statistical analysis showed a significant gender difference, with men comprising a higher percentage in the group receiving biological therapy (Table 2). Recent cohort analyses have shown differences in the age of onset of inflammatory bowel disease (IBD) between The demographic characteristics revealed a significant difference in gender distribution among groups, with women being predominantly represented among healthy participants, genders across Western and Asia-Pacific countries. Based on data from 16 Western countries, females have a lower risk of developing Crohn's disease (CD) before puberty, whereas after puberty, the risk reverses, with females exhibiting a higher risk (16,17,18).

When analyzing psychopathological symptoms using the SCL-90 scale, participants from the patient group achieved significantly higher scores in several domains, including Obsessive-Compulsive Symptoms, Depression, Anxiety, and Psychoticism (Table 3). These results indicate an increased level of psychopathological symptoms among

patients compared to healthy individuals, which may be associated with their health status. Within the group receiving biological therapy, higher scores in the domains of Obsessive-Compulsive Symptoms, Depression, and Psychoticism suggest specific psychopathological challenges associated with treatment (Table 4). These findings are consistent with previous studies that demonstrated a strong association between mental and psychological status and disease activity in patients with inflammatory bowel disease, as assessed using the SCL-90-R scale (19). Such results emphasize the importance of a systematic and holistic approach to screening and treatment that includes the assessment of mental health and related symptoms, such as pain, both in patients with active IBD and those in remission (20).

CONCLUSION

The study showed that women were predominantly represented among healthy participants, while gender distribution among patients was balanced. This may indicate gender differences in disease prevention and development. In the group of participants receiving biological therapy, men constituted the majority,

which may reflect specific epidemiological trends and variations in treatment approaches. Considering findings from other studies—such as the increased risk of Crohn's disease among women after puberty and the higher risk of ulcerative colitis among men in older age—these results may suggest the need to tailor therapeutic strategies according to gender and age. These patterns may be influenced by genetic and hormonal factors, as well as environmental conditions specific to different regions. The health status of participants was associated with higher scores on psychopathological scales (SCL-90), with patients exhibiting more pronounced symptoms such as depression, anxiety, and psychotic features. This underscores the importance of considering mental health in patients with chronic diseases, as their physical condition may be linked to an increased prevalence of psychological problems. These findings are consistent with research highlighting the connection between mental health and disease activity, suggesting the need for a holistic approach in the diagnosis and treatment of IBD.

LITERATURE

1. Zubčić M. Kvaliteta života bolesnika s upalnim bolestima crijeva liječenih biološkom terapijom [Internet] [info:eu-repo/semantics/masterThesis]. [Zagreb]: University of Applied Health Sciences; 2017 [cited 2024 Nov 20]. Available from: <https://urn.nsk.hr/urn:nbn:hr:139:562405>
2. Vucelić B, Čuković-Čavka S. Upalne bolesti crijeva. *Medicus*. 2006;15(1_Gastroenterologija):53–62.
3. Vucelić B. Upalne bolesti crijeva. *Reumatizam*. 2013;60(2):13–23.
4. Shivananda S, Lennard-Jones J, Logan R, Fear N, Price A, Carpenter L, et al. Incidence of inflammatory bowel disease across Europe: is there a difference between north and south? Results of the European Collaborative Study on Inflammatory Bowel Disease (EC-IBD). *Gut*. 1996;39(5):690–7.
5. Hodges H, Fealko C, Soares N. Autism spectrum disorder: definition, epidemiology, causes, and clinical evaluation. *Translational Pediatrics*. 2020;9(Suppl 1):S55-S5S65.
6. Restrepo B, Angkustsiri K, Taylor SL, Rogers SJ, Cabral J, Heath B, et al. Developmental-behavioral profiles in children with autism spectrum disorder and co-occurring gastrointestinal symptoms. *Autism Research*. 2020;13(10):1778–89.
7. Chaidez V, Hansen RL, Hertz-Picciotto I. Gastrointestinal Problems in Children with Autism, Developmental Delays or Typical Development. *J Autism Dev Disord*. 2014;44(5):1117–27.
8. McElhanon BO, McCracken C, Karpen S, Sharp WG. Gastrointestinal Symptoms in Autism Spectrum Disorder: A Meta-analysis. *Pediatrics*. 2014;133(5):872–83.
9. Doshi-Velez F, Avillach P, Palmer N, Bousvaros A, Ge Y, Fox K, et al. Prevalence of Inflammatory Bowel Disease Among Patients with Autism Spectrum Disorders. *Inflammatory Bowel Diseases*. 2015;21(10):2281–8
10. Lee M, Krishnamurthy J, Susi A, Sullivan C, Gorman GH, Hisle-Gorman E, et al. Association of Autism Spectrum Disorders and Inflammatory Bowel Disease. *J Autism Dev Disord*. 2017;48(5):1523–9.
11. Kohane IS, McMurry A, Weber G, MacFadden D, Rappaport L, Kunkel L, et al. The Co-Morbidity Burden of Children and Young Adults with Autism Spectrum Disorders. *PLOS ONE*. 2012;7(4):e33224.

12. Sajadinejad MS, Asgari K, Molavi H, Kalantari M, Adibi P. Psychological Issues in Inflammatory Bowel Disease: An Overview. *Gastroenterology Research and Practice*. 2012;2012(1):106502.
13. Mikocka-Walus A, Knowles SR, Keefer L, Graff L. Controversies Revisited: A Systematic Review of the Comorbidity of Depression and Anxiety with Inflammatory Bowel Diseases. *Inflammatory Bowel Diseases*. 2016;22(3):752–62.
14. Gomez R, Stavropoulos V, Zarate D, Palikara O. Symptom Checklist-90-Revised: A structural examination in relation to family functioning. *PLoS One*. 2021 Mar 12;16(3):e0247902.
15. Addiction Research Center [Internet]. [cited 2024 Nov 24]. Symptom Checklist-90 (SCL90). Available from: <https://arc.psych.wisc.edu/self-report/symptom-checklist-90-scl90/>.
16. Rustgi SD, Kayal M, Shah SC. Sex-based differences in inflammatory bowel diseases: a review. *Therap Adv Gastroenterol*. 2020;13:1756284820915043.
17. Shah SC, Khalili H, Gower-Rousseau C, Olen O, Benchimol EI, Lynge E, et al. Sex-Based Differences in Incidence of Inflammatory Bowel Diseases—Pooled Analysis of Population-Based Studies From Western Countries. *Gastroenterology*. 2018;155(4):1079-1089.e3.
18. Shah SC, Khalili H, Chen CY, Ahn HS, Ng SC, Burisch J, et al. Sex-based differences in the incidence of inflammatory bowel diseases—pooled analysis of population-based studies from the Asia-Pacific region. *Alimentary Pharmacology & Therapeutics*. 2019;49(7):904–11.
19. Ali E, Header D, Aty KA, Othman N, Fawzy M, El Amin H, et al. Correlation of mental and psychological status with disease activity in patients with inflammatory bowel disease using SCL-90 R Questionnaire. *Prz Gastroenterol*. 2024;19(2):165–74.
20. Sehgal P, Ungaro RC, Foltz C, Iacoviello B, Dubinsky MC, Keefer L. High Levels of Psychological Resilience Associated With Less Disease Activity, Better Quality of Life, and Fewer Surgeries in Inflammatory Bowel Disease. *Inflamm Bowel Dis*. 2021;27(6):791–6.

DUŠEVNO ZDRAVLJE U OBOLJELIH OD UPALNIH BOLESTI CRIJEVA

Martina Bošnjak^{1,2}, Majo Češko^{1,2}, Dragan Babić², Emil Babić², Darjan Franjić²

¹Klinika za unutarnje bolesti s centrom za dijalizu Sveučilišne kliničke bolnice Mostar,
88 000 Mostar, Bosna i Hercegovina

²Fakultet zdravstvenih studija Sveučilište u Mostaru, Mostar, Bosna i Hercegovina

SAŽETAK

Uvod: Upalne bolesti crijeva (IBD, engl. inflammatory bowel diseases) predstavljaju idiopatske, kronične upalne poremećaje koji karakteriziraju nepredvidiv tijek.

Ispitanici i metode: Presječna studija provedena je među ispitanicima oboljelima od Crohnove bolesti. Uključene su bile dvije skupine: ispitna i kontrolna. Ispitnu skupinu činilo je 100 bolesnika oboljelih od Crohnove bolesti, od kojih je 50 bilo na biološkoj terapiji, a 50 izvan biološke terapije, svi liječeni na Kliničkom odjelu za gastroenterologiju SKB-a Mostar. Ispitanici su ispunili instrumenate prilagođenih za istraživanje: sociodemografski upitnik, Symptom Checklist 90 (SCL-90).

Rezultati: U skupini zdravih ispitanika bilo je značajno više žena i oni su češće imali viši stupanj obrazovanja, dok su u većem postotku živjeli s roditeljima. Ispitanici iz skupine bolesnika su postizali značajno više rezultate u nekoliko domena psihopatoloških simptoma prema SCL-90 upitniku, uključujući opsesivno-kompulzivne simptome ($p=0,022$), depresivnost ($p=0,036$), anksioznost ($p=0,027$), psihotična obilježja ($p=0,023$), indeks pozitivnih simptoma stresa (PSDI) ($p=0,043$), indeks ukupnih teškoća (GSI) ($p=0,040$) i ukupne pozitivne simptome (PST) ($p=0,033$).

Zaključak: Ove razlike ukazuju na viši stupanj psihopatoloških simptoma kod bolesnih ispitanika u odnosu na zdrave. važnost uzimanja u obzir mentalnog zdravlja pacijenata s kroničnim bolestima, jer njihovo zdravstveno stanje može biti povezano s povećanom učestalošću psihičkih problema. Ovi nalazi su u skladu s istraživanjima koja naglašavaju povezanost između mentalnog zdravlja i aktivne bolesti, što sugerira potrebu za holističkim pristupom u dijagnosticiranju i liječenju IBD-a.

Ključne riječi: duševno zdravlje, Crohnova bolest, upalne bolesti crijeva

Autor za korespondenciju: dr. sc. Martina Bošnjak;

martinasimunovic73@gmail.com, martina.bosnjak@fzs.sum.ba

NURSING DOCUMENTATION IN HOSPITAL HEALTHCARE: INSIGHTS INTO NURSES' ATTITUDES AND PERCEPTIONS

Ivana Gusar¹  & Josipa Gregov^{1,2}

¹Department of Health Studies, University of Zadar, 23 000 Zadar, Republic of Croatia

²General Hospital Zadar, 23 000 Zadar, Republic of Croatia

Received on 7.9.2025.

Reviewed on 17.9.2025.

Accepted on 16.10.2025.



ABSTRACT

Introduction: Nursing documentation includes records of nursing interventions throughout the nursing process and ensures continuity and integration of all phases of patient care. Although legally required, nursing documentation in hospitals in Croatia is still not maintained comprehensively. Nurses' perceptions and attitudes play a key role in ensuring its consistent and complete management.

Aim: To investigate the attitudes and perceptions of nursing staff with regard to nursing documentation and its importance in hospital practice.

Materials and Methods: The qualitative study was conducted between 15 May and 3 June 2024 in Zadar General Hospital. Data were collected through semi-structured interviews based on the relevant literature.

Results: The analysis revealed three main categories. The first category concerned the importance of nursing documentation, which participants recognised as an official and comprehensive patient record, a supplement to other medical records and a means of legal protection for both patients and nurses. The second category included barriers to high-quality documentation, such as lack of time, lack of staff, inadequate electronic equipment, high patient volume and the limitations of the IBIS system. The third category related to the contribution of nursing documentation to patient safety, emphasising a holistic approach that prevents adverse events, protects patients from unsafe practices and enhances nurses' professional accountability.

Conclusion: Nurses recognize nursing documentation as essential for care quality, patient safety, and legal protection. Its quality is affected by time and staff shortages, technical limitations, workload, and inadequate adaptation of the electronic system. Nevertheless, high-quality documentation supports patient safety through monitoring, information transfer, professional accountability, and prevention of adverse events.

Keywords: Croatia, documentation, general hospitals, nursing.

Corresponding author: Ivana Gusar; igusar@unizd.hr

INTRODUCTION

One of the most important aspects of nursing practice, which is both an obligation and responsibility of all nurses, is the maintenance of nursing documentation (1). Nursing documentation is now an important tool for critical assessment, the detailed description of the patient's condition, the recording of planned and implemented nursing interventions and the evaluation of the outcomes of the healthcare provided (2). It is therefore an important tool for monitoring the quality of healthcare, rationalising costs and standardising nursing practice (3, 4). Florence Nightingale already recognised the importance of structured data collection in the mid-19th century and emphasised that thorough and systematic documentation enables the identification of problems in healthcare and improves the quality of healthcare (5). The next important step in the development of nursing documentation was taken by Virginia Henderson in the 1930s, with the introduction of the concept of health care plans (6). Since the 1970s, nursing documentation has been formally recognized and accepted worldwide as a professionally and legally binding document (7).

In the Republic of Croatia, keeping nursing documentation became a legal obligation with the adoption of the Ordinance on Nursing Documentation in Hospital Health Institutions since 2011. The aforementioned regulation defines nursing documentation as a set of data that serves to control the quality of planning and implementation of healthcare and forms an integral part of the patient's medical documentation. The obligation to record applies to all procedures performed during

24 hours, thus ensuring continuity of care and permanent availability of data to all members of the healthcare team (7).

Despite the legal obligation, nursing documentation in Croatia is still not kept comprehensively (8). This finding aligns with a recent study, which shows that nurses make nursing diagnoses in only 20.8% of cases (9), and only 47.8% of patients have complete nursing records (10). In contrast, the findings contradict a 2019 study from China, which indicated that documenting nursing care is the second most common duty performed by nurses (11). The differences in development between the two healthcare systems are likely to contribute to the issue. A qualitative study in Indonesia found that nurses often neglect nursing record-keeping due to a lack of motivation and incomplete documentation (12). A similar occurrence is noted in a study conducted by Asmirajanti et al. (2019), which found that nursing records were not kept in a timely or adequate manner. Qualitative research in Norway suggests that while nurses aim to implement healthcare plans, they find documentation time-consuming and believe it detracts from patient care (13). Nurses expect to spend little time on documentation (12).

The development of informatics technology in recent decades has significantly influenced the way nursing documentation is maintained (14). The implementation of hospital informatics systems has enabled the digitalization of healthcare documentation, which contributes to more efficient work and significantly faster and greater availability of data. In the Republic of Croatia, the implementation of the Integrated Hospital Informatics System covers all segments of

medical documentation, including nursing documentation, but in practice, certain difficulties are often highlighted, such as technical limitations, insufficient informatics equipment, or the need for multiple data entry (15).

The results of international research show that well-managed nursing documentation contributes to better communication within the team and greater patient safety (3, 4), but also that nurses encounter various obstacles in the practice of applying nursing documentation. The most common ones are lack of time, heavy administrative burden and limited informatics resources (16, 17). Studies conducted around the world confirm that electronic documentation systems can significantly increase work efficiency, but can also cause frustration if they are not adapted to the needs of users (3, 16, 18). Previous research in Croatia and the surrounding region shows that nurses perceive documentation as an important element of professional responsibility and legal protection, but they also highlight administrative difficulties and the need for additional education (8, 19).

Based on historical development, professional significance, legal regulations and previous research, it is clear that nursing documentation is not just an administrative obligation, but a key element that connects all aspects of healthcare. The quality of its management directly reflects on patient safety, the effectiveness of healthcare and the professional responsibility of nurses. In this context, examining nurses' attitudes and experiences regarding nursing documentation management is important for a better understanding of the barriers in

practice and for finding opportunities to improve this segment of healthcare.

Therefore, this study aimed to investigate the attitudes and perceptions of nursing staff with regard to nursing documentation and its importance in hospital practice.

MATERIALS AND METHODS

The qualitative study was conducted at Zadar General Hospital between 15 May 2024 and 3 June 2024 through face-to-face interviews with the participants. Inclusion criteria for participation in the study included bachelor's or master's degrees in nursing, being actively employed at the Zadar General Hospital, having at least one year of clinical experience, participating in daily nursing documentation, and providing informed consent to participate in the study. Exclusion criteria were: nurses who do not actively participate in document management, have less than one year of work experience, are temporarily not engaged in clinical work (e.g., on sick leave or maternity leave), and do not agree to participate. The sample size was determined using the principle of data saturation, including participants until additional interviews no longer produced new information.

After the participants had been informed about the purpose and objectives of the study and had given their consent, they were interviewed on their respective hospital wards at pre-arranged times. Participation in the study was voluntary and the interviews were conducted on 14 hospital wards with a total of 12 nurses with a bachelor's degree and 2 nurses with a master's degree who were actively involved in the work process. All participants completed the study, with no

withdrawals occurring during data collection.

Instruments

The data were collected through semi-structured interviews, allowing a combination of prepared questions and flexibility to explore additional topics. The interview was divided into two parts: the first part dealt with the socio-demographic data of the participants, including age, gender, educational level and professional experience; the second part comprised questions specifically related to nursing documentation, such as: "Please specify what you mean by the term nursing documentation?" or "Are there any challenges you face when maintaining nursing records?". The questions were formulated on the basis of a prior review of the relevant literature (12, 20–25).

Data analysis

The data collected from the participants through the interview method was recorded in writing, after which a thematic analysis of the data collected through the interview was conducted. In a first step, the researchers were introduced to the collected data in detail, followed by the reduction of the collected data, a clear documentation of the data, i.e. data coding,

and finally the drawing of conclusions. The conclusions were categorized into specific categories/themes from which the main categories and subcategories were derived. The analysis process involved returning from the main themes to the codes and then to the original data to ensure the reliability and validity of the results.

The conduct of the study was approved by the Ethics Committee of the Zadar General Hospital at its 11th meeting on 29 March 2024 (Ref. No. 01-2658/24-9/24). All participants gave informed consent to participate in the study.

RESULTS

Participant characteristics

A total of 12 bachelor's and two master's graduates in nursing took part in the study, with an average age of 35 and an average length of service of 12 years. The interviewees worked in the departments of cardiology, traumatology, urology, general and pediatric surgery, intensive care medicine, pulmonology, coronary care unit, pediatrics, nephrology, hemodialysis, gastroenterology, neurosurgery and neurology. The majority of respondents (8/14) had participated in medical record keeping training in the past year. The demographic data of the respondents is shown in Table 1.

Table 1. Demographic data of respondents

Variable	N	%
Gender		
Male	2	14.29
Female	12	85.71
Age		
24-29	7	50.00
30-40	5	35.71
>41	2	14.29
Work experience (years)		
2-9	10	71.42
10-20	2	14.29
>21	2	14.29
Level of education		
Bachelor of Nursing	12	85.71
Master of Nursing	2	14.29

Attitudes and opinions of nurses about keeping nursing records

The main topic of this study was the quality of nursing documentation, which comprised three main categories relating to the importance of nursing documentation, barriers to the quality of nursing documentation and the contribution of the

quality of nursing documentation to patient safety. Within the first category there are a total of five subcategories, and within the second and third categories there are seven subcategories each. An overview of the main categories and subcategories is shown in Table 2.

Table 2. Main categories and subcategories of nursing documentation quality

Theme	Main categories	Subcategories
Quality of nursing documentation	The importance of quality nursing documentation	Official document; Complete data; Control and monitoring of healthcare; Supplement to other medical documentation; Legal protection of patients and nurses
	Barriers to the quality of nursing documentation	Lack of time; Lack of staff; Lack of informatics equipment; Large number of patients; Inadequate adaptation of IBIS to certain categories of patients; Insufficient data; Copying of previous data
	The contribution of nursing documentation quality to patient safety	Continuous monitoring of the patient's condition; Easy transfer of information; Encourages professional responsibility; Detailed insight into the patient's condition; Holistic approach; Prevents adverse events; Protects the patient from unsafe practices

The importance of quality nursing documentation

Participants emphasize that nursing documentation is an official document and a legal obligation, the quality of which is crucial for legal protection, patient safety, and the quality of healthcare provided. Respondent 6 states: "Nursing documentation is an official document... irregularities can be noticed and controlled promptly." Respondent 7 adds: "I am positively influenced by the motivation from the head nurse, but also by self-protection when I document everything that is done."

The completeness of the documentation allows patient monitoring from admission to discharge and continuous data recording. Respondent 1 points out: "Nursing documentation includes all information recorded from the time of admission to the hospital until the patient is discharged." Respondent 12 adds: "Nursing documentation is a set of data that nurses record chronologically and continuously, for the purpose of supplementing the written handover." The documentation also facilitates communication and information transfer within the team. Respondent 3 states: "The

continuous monitoring of the patient's condition and facilitated information transfer are the greatest advantages of maintaining nursing documentation." Respondent 4 emphasizes: "It serves as an aid when transferring the patient to another department or when being discharged."

Legal protection is a strong motivating factor. Respondent 10 adds: "Legal protection... confirms that we have provided appropriate health care."

Barriers to the quality of nursing documentation

Participants identify seven main barriers. The most common are a lack of time and staff. Respondent 7 states: "Nursing documentation is negatively affected by lack of time due to lack of staff and excessive workload." Respondent 2 adds: "The work needs to be redistributed so that one nurse can write documentation without interruption and the patients are taken care of."

The lack of informatics equipment also makes data entry difficult. Respondent 1 says: "The biggest challenge is the lack of computers in the departments because most of the time everyone is busy." Respondent 6 suggests: "Two tablets can be purchased... which is more feasible than increasing staff."

Other barriers include too many patients, inadequate electronic documentation, duplication of data and insufficient quality of records. Respondent 2 notes: "The decursuses should not contain just one word 'sleep' or 'round', but should be meaningful in content." Respondent 10 adds: "As I sat down at the computer and started entering data, the alarm rang, and the data was already needed by someone and deleted."

The contribution of nursing documentation quality to patient safety

Participants highlight seven subcategories that contribute to patient safety. Continuous monitoring of the condition allows for timely recognition of changes and care planning. Respondent 3 states: "Nursing documentation enables continuous monitoring of the patient's condition and facilitates the transfer of information about the patient." Respondent 6 adds: "Continuous monitoring of the patient's condition and legal protection are the greatest advantages of keeping records."

Easy transfer of information and professional accountability improve coordination within the team. Respondent 9 says: "Nursing documentation ensures legal protection, continuous monitoring of the patient's condition and facilitates access to data." Respondent 4 emphasizes: "Keeping nursing documentation encourages professional accountability of nurses."

Detailed insight into the patient's condition and a holistic approach to the patient enable a comprehensive examination and planning of healthcare. Respondent 2 states: "The advantages are a complete insight into both the patient's condition and the medical and technical procedures performed." Respondent 10 adds: "The biggest advantages are systematic monitoring of the patient's condition, a holistic approach and easier communication within the team."

Nursing documentation also contributes to the prevention of adverse events and the reduction of the risk of unsafe practices. Respondent 8 points out: "We record all procedures and therapies performed in the decursus... which leaves no room for

error.” Respondent 3 adds: “Documentation increases patient safety because it ensures continuous monitoring and availability of information.” Respondent 6 concludes: “With all the written data, nurses have a better insight into the entire patient care process.”

DISCUSSION

This research aimed to examine the attitudes and opinions of nurses on the maintenance of nursing documentation and its importance in hospital practice. Although the participants are employees of only one health institution, their sociodemographic characteristics are similar to the population of nurses employed in the Republic of Croatia. Namely, a similar gender distribution, average age of the respondents and length of service have been shown in previous research (26, 27).

The recorded results indicate the nurses' awareness of the importance of the quality of nursing documentation. Similar results were published in a recent study highlighting how nurses understand the importance of quality nursing documentation (28). Respondents in this study emphasize that nursing documentation is an official document that supplements other medical documentation and requires comprehensive data that serves to control and monitor healthcare, which is confirmed by previous research (7). Furthermore, respondents recognize nursing documentation as a means of legal protection for both nurses and patients. Similar results are reported in a study from 2021 that describes the importance and strength of nursing documentation as part of the patient's medical documentation in misdemeanor or even criminal court

proceedings (29). For example, it is stated that nursing documentation should not be viewed separately from patient care, but rather, on the contrary, it belongs to the patient care process (30).

In this research, the main obstacles to the quality of nursing documentation are highlighted as lack of time, lack of staff and technical difficulties, which is in line with the results of previous studies (17, 31). In the study by Bjerkan et al., highlighted barriers, in addition to lack of time and staff, included the complexity of nursing documentation and the lack of standardization of the informatics system (32), which partly confirms the findings of this research. The lack of time and staff, which is currently particularly pronounced in health institutions (33), causes incomplete or inadequate documentation, which can increase the risk of medical errors and adverse events and affect the continuity and quality of healthcare (7, 34). Furthermore, similar results were recorded in a study conducted in Iran, where lack of time, lack of staff, technical difficulties and insufficient education of nurses were also cited as the main challenges (20). In this research, education was not particularly emphasized, which is probably a consequence of the fact that all respondents had previously attended education, most of them in the previous year. Namely, other research also directly links the maintenance of nursing documentation with the education of nurses and the level of education (35). One of the obstacles that respondents cited was missing data and copying of previous patient data, which significantly impairs the quality of nursing documentation (36). Although digital hospital informatics systems are recognized as a significant tool

for improving the efficiency and quality of nursing documentation, respondents perceive it as an obstacle and a significant challenge, which has been confirmed in other research (16). For example, a study conducted in Nigeria reported that half of nurses faced at least minor challenges when using digital nursing records, while 36.8% of nurses reported experiencing moderate challenges (16). Furthermore, research participants point out that the current implementation of electronic documentation still has limitations: insufficient computers, unsuitability for certain departments, and duplication of data entry, which was also confirmed in a study conducted in Iran (18). Nurses emphasize that they are ready to use electronic nursing documentation, but that certain problems in the implementation and use of the software must first be resolved to make the system more easily acceptable (18). Similar problems in the digitalization of documentation were observed in the study by Dall'Ora et al., which emphasizes that the use of tablets, for example, can reduce the time spent on documentation and allow more time for direct patient care (37).

Despite the above obstacles, the participants in this study clearly emphasize that comprehensive nursing documentation contributes to patient safety in the hospital healthcare system. Namely, documentation offers a view of continuous patient monitoring through detailed insight into the patient's condition and a holistic approach (7). Nursing documentation ensures the easy transfer of information and encourages professional responsibility of nurses. Ultimately, respondents state that complete and high-quality nursing documentation protects patients from

unsafe practices and thus directly prevents adverse events (32).

Limitations

This research had certain limitations. The primary limitation is related to the small sample size of the nursing staff. Furthermore, because the study only evaluated a single hospital, the applicability of the results may be restricted. Moreover, the interviews were conducted face-to-face, which could have influenced the respondents' honesty and led to them giving desirable answers.

CONCLUSION

Nurses understand that quality nursing documentation is crucial for ensuring patient safety and enhancing healthcare efficiency. They have identified several key obstacles to effective and comprehensive nursing documentation, including a lack of time, staff, and technical resources. By improving working conditions and optimizing information systems, it is possible to enhance nurses' attitudes and perceptions toward nursing documentation. This can lead to better management of nursing documentation, a reduction in the risk of errors, and ultimately, an overall improvement in patient care.

REFERENCES

1. Samani S, Rattani SA. Fostering Patient Safety: Importance of Nursing Documentation. *Open Journal of Nursing*. 2023;13(07):411–28.
2. Yuwanto MA, Prasetyo RE. Implementation of Nursing Care Documentation Based on Indonesian Nursing Care Standards (SDKI, SLKI, and SIKI) in Hospitals. *Blambangan Journal of*

- | Community | Services | (BJCS). |
|---|----------|---|
| 2023;1(1):17–23. | | |
| 3. Martínez-Muñoz I, Díaz-Agea JL, Pastor-Rodríguez JD. Perception of Pediatric Nurses on the Use of Standardized Nursing Handover Process in Intra-Hospital Patients Transfer: Attitudes, Barriers, and Practical Challenges. <i>Nursing Reports</i> . 2024;14(4):3722–36. | | 10. Tasew H, Mariye T, Teklay G. Nursing documentation practice and associated factors among nurses in public hospitals, Tigray, Ethiopia. <i>BMC Research Notes</i> [Internet]. 2019;12(1):1–6. |
| 4. Nakate GM, Dahl D, Petrucka P, B. Drake K, Dunlap R. The Nursing Documentation Dilemma in Uganda: Neglected but Necessary. A Case Study at Mulago National Referral Hospital. <i>Open Journal of Nursing</i> . 2015;05(12):1063–71. | | 11. Yu P, Song L, Qian S, Yao X, Huang J, Min L, et al. Work pattern of neurology nurses in a Chinese hospital: A time and motion study. <i>Journal of Nursing Management</i> . 2019;27(2):320–9. |
| 5. Chelagat D, Sum T, Chebor A, Kipto R, Bundtich P. Documentation : Historical perspectives , purposes , benefits and challenges as faced by nurses. <i>International Journal of Humanities and Social Science</i> [Internet]. 2013;3(16):236–40. | | 12. Kamil H, Rachmah R, Wardani E. What is the problem with nursing documentation? Perspective of Indonesian nurses. <i>International Journal of Africa Nursing Sciences</i> [Internet]. 2018;9:111–4. |
| 6. Lopez M, Jimenez JM, Fernández-Castro M, Martin-Gil B, Garcia S, Cao MJ, et al. Impact of nursing methodology training sessions on completion of the Virginia henderson assessment record. <i>Nursing Reports</i> . 2020;10(2):106–14. | | 13. Vabo G, Slettebø Å, Fossum M. Participants' perceptions of an intervention implemented in an Action Research Nursing Documentation Project. <i>Journal of Clinical Nursing</i> . 2017;26(7–8):983–93. |
| 7. Hanžek K. Nursing documentation as important part of the medical documentation. <i>Liječnicki Vjesnik</i> . 2024;2024(1–2):62–6. | | 14. Shafiee M, Shanbehzadeh M, Nassari Z, Kazemi-Arpanahi H. Development and evaluation of an electronic nursing documentation system. <i>BMC Nursing</i> . 2022;21(1):1–12. |
| 8. Gusar I, Lazinica A, Klarin M. Work motivation, job satisfaction, and nursing record-keeping: Do they differ in surgery and internal disease departments? <i>Central European Journal of Nursing and Midwifery</i> [Internet]. 2020;11(4):163–70. | | 15. Poje I, Braović M. Bolnički informacijski sustav - prednosti i nedostaci u radu. <i>Zdravstveno veleučilište, Diplomski specijalistički studij Menadžment u sestrinstvu</i> . 2019;25(1):20–8. |
| 9. Asmirajanti M, Hamid AYS, Hariyati RTS. Nursing care activities based on documentation. <i>BMC Nursing</i> . 2019;18(Suppl 1):1–5. | | 16. Ogbeide OT, Nwaomah EE, Nwabudike E, Akingbade O. Challenges with Electronic Documentation Among Nurses in Public Hospitals in Lagos Island. <i>International Journal of Nursing, Midwife and Health Related Cases</i> . 2022;8(3):45–57. |
| | | 17. Bibi A, Naz N, . B, Ali S, Awan MN, Sultan A. Barriers Face by Nurses Regarding Proper Nursing Documentation at Teaching Hospitals Peshawar Pakistan. |

- Pakistan Journal of Medical and Health Sciences. 2023;17(4):173–8.
18. Heidarizadeh K, Rassouli M, Manoochehri H, Zagheri Tafreshi M, Kashef Ghorbanpour R. Nurses' Perception of Challenges in the Use of an Electronic Nursing Documentation System. *CIN - Computers Informatics Nursing*. 2017;35(11):599–605.
19. Marušić J, Hajdarević A, Spasojević N, Eminović E, Mušanović S, Ovčina A. Health Care Documentation Management in Hospital Conditions. *Journal of applied health sciences*. 2020;6(2):201–18.
20. Vafaei SM, Manzari ZS, Heydari A, Froutan R, Farahani LA. Nurses' perception of nursing services documentation barriers: A qualitative approach. *Electronic Journal of General Medicine*. 2018;15(3):3–10.
21. Petkovšek-Gregorin R, Skela-Savič B. Nurses' perceptions and attitudes towards documentation in nursing. *Obzornik zdravstvene nege*. 2015;49(2):106–25.
22. Darmer MR, Ankersen L, Nielsen BG, Landberger G, Lippert E, Egerod I. The effect of a VIPS implementation programme on nurses' knowledge and attitudes towards documentation. *Scandinavian Journal of Caring Sciences*. 2004;18(3):325–32.
23. Wahyuni ED, Nursalam, Dewi YS, Susiana E, Asmoro CP, Kamel AD. Nurse's individual factor may influence quality of nursing documentation in the inpatient room. *Journal of the Pakistan Medical Association*. 2023;73(2):S88–91.
24. Tajabadi A, Ahmadi F, Sadooghi Asl A, Vaismoradi M. Unsafe nursing documentation: A qualitative content analysis. *Nursing Ethics*. 2020;27(5):1213–24.
25. Blair W, Smith B. Nursing documentation: Frameworks and barriers. *Contemporary Nurse*. 2012;41(2):160–8.
26. Gusar I, Šijan D, Sorić T, Šare S, Županović M, Ljubičić M. Predictors of Croatian nurses' turnover intention: A cross-sectional study. *Health Policy*. 2025;
27. Tokić A, Gusar I, Nikolić Ivanišević M. Zadovoljstvo poslom i mentalno zdravlje u Hrvatskoj u vrijeme pandemije COVID-19. *Društvena istraživanja*. 2021;30(2):401–21.
28. Mabunda NF, Masondo IG, Mokoena-De Beer AG. Nurses' understanding of quality documentation: A qualitative study in a Mental Health Institution. *Curationis*. 2025;48(1):1–8.
29. Mulyana M, Santiago F. Juridical Review of Medical Record as a Mean of Legal Protection for Nurse. In: *Proceedings of the 1st International Conference on Law, Social Science, Economics, and Education, ICLSSEE [Internet]. Proceedings of the 1st International Conference on Law, Social Science, Economics, and Education, ICLSSEE 2021, March 6th 2021, Jakarta, Indonesia; 2021. Available from: <https://eudl.eu/doi/10.4108/eai.6-3-2021.2306394>*
30. Cartwright-Vanzant RC. Medical record documentation: Legal aspects in neonatal nursing. *Newborn and Infant Nursing Reviews*. 2010;10(3):134–7.
31. Ngozi AL, Dioso RI, Anyebe EE. Factors Influencing Documentation in Nursing Care by Nurses at the Federal Medical Centre, Apir, Benue State, Nigeria. *Malaysian Journal of Nursing*. 2024;16(2):63–73.

32. Bjerkan J, Valderaune V, Olsen RM. Patient Safety Through Nursing Documentation: Barriers Identified by Healthcare Professionals and Students. *Frontiers in Computer Science*. 2021;3(June):1–11.
33. Haddad L, Annamaraju P, Toney-Butler T. Nursing Shortage [Internet]. Treasure Island; 2018. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK493175/>
34. Khairunisa F. The Effectiveness of Application of Electronic-Based Nursing Documentation in Improving Health Services: Literature Review. *Indonesian Journal of Community Health Nursing*. 2023;8(2):52–7.
35. Mayenti F, Arif Y, Priscilla V. Analysis of Factors Related to The Documentation of Nursing Care. *STRADA Jurnal Ilmiah Kesehatan*. 2020;9(2):503–14.
36. Ernawati, Abbasiah, Yellyanda, Amni D. Determinants of Incomplete Documentation of Nursing Care: A Cross-Sectional Study. *Evidence Based Care Journal*. 2025;14(4):37–42.
37. Dall'Ora C, Griffiths P, Hope J, Barker H, Smith GB. What is the nursing time and workload involved in taking and recording patients' vital signs? A systematic review. *Journal of Clinical Nursing*. 2020;29(13–14):2053–68.

SESTRINSKA DOKUMENTACIJA U BOLNIČKOJ ZDRAVSTVENOJ ZAŠTITI: UVID U STAVOVE I PERCEPCIJU MEDICINSKIH SESTARA

Ivana Gusar¹  & Josipa Gregov^{1,2}

¹Sveučilište u Zadru, Odjel za zdravstvene studije, 23 000 Zadar, Republika Hrvatska

²Opća bolnica Zadar, 23 000 Zadar, Republika Hrvatska

SAŽETAK

Uvod: Sestrinska dokumentacija obuhvaća zapise o postupcima medicinskih sestara tijekom zdravstvene njege te osigurava kontinuitet i povezanost svih faza zdravstvene skrbi. Iako je zakonski obvezna, sestrinska dokumentacija u bolnicama u Hrvatskoj još uvijek se ne vodi cjelovito. Percepcija i stavovi medicinskih sestara imaju ključnu ulogu u osiguravanju njezinog dosljednog i cjelovitog vođenja.

Cilj: Ispitati stavove i mišljenja medicinskih sestara o vođenju sestrinske dokumentacije i njezinoj važnosti u bolničkoj praksi.

Materijali i metode: Kvalitativno istraživanje provedeno je u Općoj bolnici Zadar od 15. svibnja do 3. lipnja 2024. godine. Podaci su prikupljeni polu-strukturiranim intervjuom koji je temeljen na dostupnoj relevantnoj literaturi.

Rezultati: Analizom podataka kao glavna tema izdvojila se kvaliteta sestrinske dokumentacije unutar koje su izdvojene tri glavne kategorije. Prva je važnost sestrinske dokumentacije, koju ispitanici prepoznaju kao službeni i cjeloviti dokument, dopunu medicinskoj dokumentaciji te sredstvo pravne zaštite. Druga su prepreke kvalitetnom vođenju dokumentacije, među kojima dominiraju nedostatak vremena, osoblja, informatičke opreme, velik broj pacijenata te neprilagođenost elektronske dokumentacije. Treća kategorija odnosi se na doprinos sestrinske dokumentacije sigurnosti pacijenata kroz holistički pristup, prevenciju neželjenih događaja i jačanje profesionalne odgovornosti.

Zaključak: Medicinske sestre prepoznaju sestrinsku dokumentaciju kao ključan element kvalitete skrbi i sigurnosti pacijenata te kao pravnu zaštitu pacijenata i osoblja. Kvalitetu dokumentacije otežavaju nedostatak vremena i osoblja, tehnička opremljenost, preopterećenost i neadekvatna prilagodba elektronskog sustava. Unatoč tome, kvalitetna dokumentacija doprinosi sigurnosti pacijenata kroz praćenje stanja, olakšan prijenos informacija, profesionalnu odgovornost i prevenciju neželjenih događaja.

Ključne riječi: Hrvatska, dokumentacija, opće bolnice, sestринство.

Autor za korespondenciju: Ivana Gusar; igusar@unizd.hr

THYROID SCINTIGRAPHY. INCIDENCE OF THYROID CARCINOMA IN COLD NODE

Marko Krpan^{ID}, Bruno Rajič^{ID}, Marin Brajković^{ID}

University Clinical Hospital Mostar, 88 000 Mostar, Bosnia & Herzegovina

Received on 26.9.2025.

Reviewed on 13.10.2025.

Accepted on 5.11.2025.



SUMMARY

Introduction: Thyroid cancer is one of the most common malignant diseases of the endocrine system, and its changes are often asymptomatic in the early stages. Cold thyroid nodules are often suspicious and require further diagnostic testing to exclude a malignant character. Diagnostic methods such as scintigraphy, ultrasound, cytological puncture and pathohistological analysis are key to correctly distinguishing benign and malignant lesions. This paper analyzes the incidence of thyroid cancer in patients with cold nodules, with the aim of assessing the efficiency of different diagnostic methods in detecting malignant changes.

Objective: To assess the incidence of thyroid cancer in scintigraphically proven cold nodules.

Subjects and methods: The study included 98 patients who underwent thyroid scintigraphy in the period 2023-2024 due to suspected cold nodules. In all cases, additional diagnostic procedures were performed: ultrasound examination, aspiration cytology puncture and pathohistological analysis of tissue samples. Age, gender and diagnostic methods for determining the nature of the nodule were analyzed.

Results: Of the 98 patients, the majority of patients were between 60 and 79 years of age (43%). Women accounted for 78.6% of the subjects. The results showed that malignant thyroid carcinoma was diagnosed in 7.1% of the subjects. Cytology puncture showed high sensitivity (93%) and specificity (100%) in diagnosing benign and malignant lesions. The most common benign finding was follicular adenoma, while malignant changes were most often papillary carcinomas.

Conclusion: Scintigraphy, ultrasound and cytology puncture are key methods in the evaluation of cold thyroid nodules, with cytology puncture being the most sensitive for distinguishing benign from malignant lesions. The risk of malignancy in this study was 7.1%, with a higher proportion in men.

Keywords: Thyroid carcinoma, cold nodule, scintigraphy

Corresponding author: Marko Krpan, mag.rad.teh.; marko.krpanb@gmail.com

INTRODUCTION

Thyroid cancer is among the most common malignant diseases of the endocrine system, with a global incidence that is constantly increasing (1,2). Although many thyroid cases are benign, accurate diagnosis of malignant changes requires the use of various diagnostic methods (3). Cold thyroid nodules represent one of the most important diagnostic challenges, as they are asymptomatic and often go unrecognized until they become the cause of serious clinical problems (4,5). Cold nodules are nodules that do not show radioactive activity on thyroid scintigraphy, meaning that they do not behave like active nodules that typically take up radiopharmaceuticals (6). Therefore, these nodules often require further evaluation to exclude malignancy (7,8).

In the early stages, most cold thyroid nodules are benign, but the assessment of malignancy remains a challenge (9). Differentiation between benign and malignant changes in the thyroid gland requires the use of various diagnostic methods, including ultrasound, thyroid scintigraphy, cytological puncture, and histopathological analysis (10,11). Thyroid scintigraphy, which uses radiopharmaceuticals to record thyroid activity, is one of the key tools for identifying cold nodules (12). Ultrasound examination is an additional complementary method that allows visualization of the structure of the nodule and its characteristics, such as size, shape, and borders (13). Although these methods are very useful, the final diagnosis is often made by cytological puncture and histopathological analysis, which allow precise differentiation between benign and

malignant lesions (14,15). Thyroid biopsy is a minimally invasive procedure used to obtain tissue samples from a nodule and analyze them under a microscope. This method provides high sensitivity and specificity in detecting malignant changes, especially when used in combination with ultrasound. However, in certain cases, cytology may yield indeterminate results that require additional histopathological analysis for a definitive diagnosis (16). Histopathological processing of the tissue, which is performed after surgical removal of the nodule, provides a definitive answer about the malignancy and tumor type (17). Although the incidence of malignant thyroid nodules is relatively low, accurate diagnosis is essential to avoid inadequate treatment and to enable timely surgical removal of malignant lesions. Malignant thyroid cancer is most often diagnosed in the adult population, especially in older age, and women are more susceptible to the disease than men. There are also known genetic predispositions and risk factors such as a positive family history of thyroid disease, radiation exposure, and hormonal changes that increase the likelihood of developing malignancy (18).

The diagnosis of malignancy in thyroid cold nodules can be significantly improved by the correct choice of diagnostic procedures. This paper investigates the incidence of malignant changes in patients with scintigraphically proven thyroid cold nodules and evaluates the efficiency of different diagnostic methods in distinguishing benign and malignant lesions. Special focus is placed on the role of cytological puncture in establishing the diagnosis, as well as the need for further pathohistological analyses in cases of indeterminate cytological findings. Given

the increased prevalence of thyroid diseases, the aim of this study is to provide a clear picture of the incidence of malignant changes among patients with cold nodules, with an analysis of the role of each diagnostic procedure in the diagnostic process. The study also examines the influence of gender, age and other factors on the incidence of malignant nodules, which is crucial for improving clinical practice in early diagnosis and timely treatment of thyroid diseases.

OBJECTIVE OF THE RESEARCH

The aim of the study is to assess the risk of malignancy, the influence of clinical indicators on the risk of malignancy, and to investigate the distribution of cytological findings and pathohistological diagnoses in distinguishing benign from malignant lesions in a group of patients with ultrasound-proven solitary and scintigraphically proven "cold" nodules.

RESPONDENTS AND METHODS OF WORK

For the purposes of the study, a retrospective study was conducted at the Clinical Institute of Nuclear Medicine of the University Hospital in Mostar. The study covered the period from 2023 to 2024. The study included 98 patients, of whom 77 were women (78.6%) and 21 were men (21.4%), aged 10 to 89 years.

After thyroid scintigraphy, patients underwent additional diagnostic methods including ultrasound, aspiration cytological puncture, and laboratory tests of thyroid hormones. All patients with suspicious findings on scintigraphy, including those with indeterminate cytological results, underwent pathohistological analysis of thyroid tissue samples. The results were

analyzed in relation to gender, age, type of findings, and type of diagnostic procedure, and in particular the accuracy of cytological diagnosis compared to pathohistological findings was analyzed.

Scintigraphy

Thyroid scintigraphy was performed using 185 MBq of ^{99m}Tc-pertechnetate injected intravenously. Static imaging was performed 20 minutes after radionuclide administration. A single-head gamma camera with a 5 mm pinhole collimator was used to collect 200,000 pulses with an absorption maximum at 140-keV.

Cytological processing

Cytological samples were obtained by ultrasound-guided FNA method (Fine Needle Aspiration). The node was punctured, and the needle was withdrawn by aspirating the content of the node.

Pathohistological processing

After removing the node, pathohistological processing was performed. The cuts are routinely impregnated with paraffin, several cuts are made in different planes.

STATISTICAL ANALYSIS

Descriptive statistics were used for statistical analysis of data, including frequency and percentage distributions for basic demographic characteristics of the subjects (age, gender). To assess the association between diagnostic methods and findings, the χ^2 -test was used to analyze differences in the frequency of malignant and benign lesions among different groups (by gender and age) and the test to compare the sensitivity and specificity of cytological findings in

relation to pathohistological findings.

Statistical significance was set at $p < 0.05$.

Table 1. *Classification of changes according to cytological diagnosis*

Type of change	Cytological diagnosis
Benign changes	Nodular goiter
	Hashimoto's thyroiditis
	Pseudocystic change
Malignant changes	Papillary carcinoma
Unspecified changes	Cellular follicular change
	Follicular neoplasm
	Adenomatoid node
	Hurthle cell tumor

RESULTS

This section presents the demographic data of the subjects, the results of cytological and histopathological analysis, and the

overall incidence of carcinoma in cold thyroid nodules.

Table 2. *Distribution of respondents by age*

Age in years	Number of respondents	Share (%)
10-19	4	4,1
20-29	3	3,1
30-39	10	10,2
40-49	14	14,3
50-59	18	18,4
60-69	26	26,5
70-79	16	16,3
80-89	7	7,1
Total:	98	100

The age distribution of all subjects included in the study is shown. The

majority of patients are in the age range between 41 and 69 years.

Table 3. *Gender of respondents*

Respondent's gender	Number of respondents	Share (%)
Male	21	21,4
Female	77	78,6
Total:	98	100

The table shows the distribution of subjects with cold thyroid nodules by gender. A

higher prevalence of females was observed compared to males.

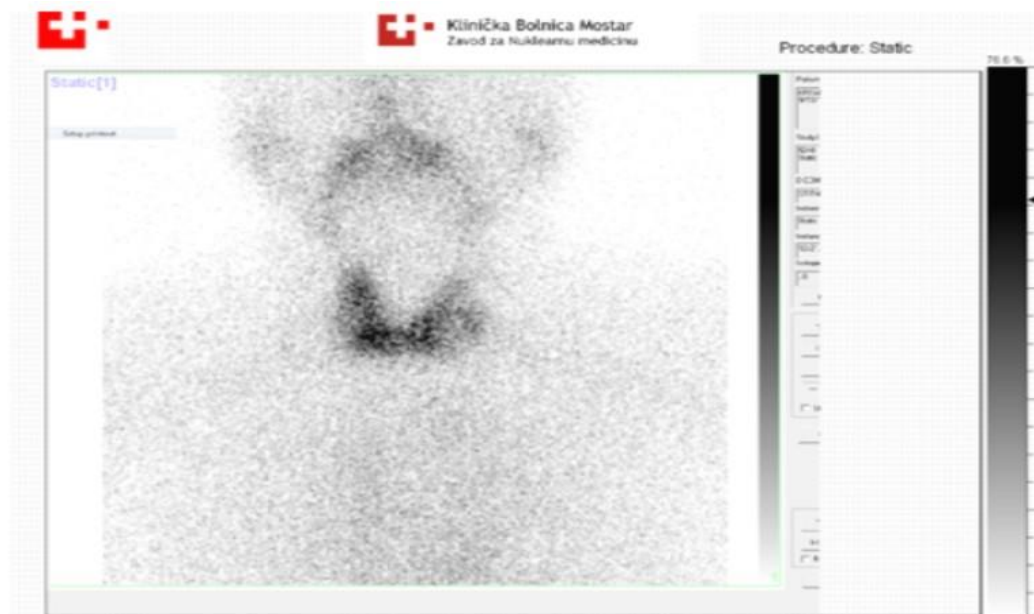


Figure 1. Static thyroid scintigram. Showing a cold nodule in a 69-year-old man.

Table 4. Distribution of cytological findings groups

Cytological finding group	Number of cases	Share (%)
Benign finding	52	53,1
Indeterminate finding	39	39,8
Malignant finding	7	7,1
Total	98	100

The table shows the distribution of cytological findings obtained by puncture of cold thyroid nodes. The majority of subjects had benign findings (53.1%), while malignant cytological findings were

determined in 7.1% of cases. Indeterminate findings, which include atypia and suspicious changes, accounted for 39.8% of all findings.

Table 5. Distribution of cytological findings

Cytological findings	Number of cases	Share(%)
Papillary carcinoma	7	7,1
Follicular neoplasm	19	19,5
Hashimoto's thyroiditis	2	2
Nodular goiter	40	40,1
Adenomatoid node	9	9,3
Hurthle cell adenoma	3	3,3
Pseudocyst	6	6,2
Thyocyte proliferation	12	12,5
Total	98	100

The table shows the detailed distribution of individual cytological diagnoses obtained by aspiration cytology of cold thyroid nodules. The most common finding was nodular goiter, present in 40.1% of cases.

Follicular neoplasm was recorded in 19.5% of subjects, while papillary carcinoma was detected in 7.1% of cases. Other findings included thyocyte proliferation (12.5%), adenomatoid nodule (9.3%), pseudocyst

(6.2%), Hurthle cell tumor (3.3%), and Hashimoto's thyroiditis (2%).

Table 6. *Distribution of cytological findings by gender*

Cytological finding group	Gender		Total
	Male	Female	
Benign finding	6	46	52
Indeterminate finding	8	31	39
Malignant finding	2	5	7
Total	21	77	98

The table shows the distribution of cytological findings by gender. Of the 98 patients, 77 (78.6%) were female and 21 (21.4%) were male. Benign findings were significantly more common in women (46

cases) than in men (6 cases). Indeterminate findings were recorded in 31 women and 8 men, while malignant findings were determined in 5 women and 2 men.

Table 7. *Distribution of pathohistological diagnoses (PHD)*

PHD	Number of cases	Share (%)
Nodular goiter	5	20,8
Follicular adenoma	11	45,8
Hurthle cell adenoma	2	8,3
Follicular carcinoma	1	4,2
Papillary carcinoma	5	20,9
Total	24	100

The table shows the distribution of histopathological diagnoses in 24 patients who underwent surgical treatment and histopathological analysis. The most common diagnosis was follicular adenoma,

present in 11 cases (45.8%), while papillary carcinoma and nodular goiter were recorded in 5 cases each (20.8% and 20.9%). Hurthle cell adenoma was diagnosed in 2 patients (8.3%), and follicular carcinoma in 1 patient (4.2%).

Table 8. *Distribution of pathohistological diagnoses (PHD) by gender*

PHD	Gender		
	Male	Female	Total
Nodular goiter	0	5	5
Follicular adenoma	3	8	11
Hürthle cell adenoma	1	1	2
Follicular carcinoma	0	1	1
Papillary carcinoma	1	4	5
Total	5	19	24

The table shows the distribution of histopathological diagnoses by gender of patients who underwent surgery. Of the 24 patients, 5 were male and 19 were female. The most common diagnosis in both sexes was follicular adenoma, with a total of 11 cases (3 males and 8 females). Papillary

carcinoma was recorded in 5 cases (1 male and 4 females), while all nodular goiters (5 cases) were diagnosed in females. Follicular carcinoma occurred in only one female patient, and Hürthle cell adenoma was evenly distributed between the genders (1 male and 1 female).

Table 9. Overall incidence of thyroid carcinoma in scintigraphically proven cold nodule

Tumor	Number of cases	Share (%)
Papillary carcinoma	6	6,1
Follicular carcinoma	1	1
Other diagnoses (benign)	91	92,9
Total	98	100

The table shows the overall incidence of malignant thyroid tumors in patients with a cold nodule confirmed by scintigraphy. Out of a total of 98 analyzed cases, a malignant tumor (carcinoma) was diagnosed in 7 patients, which accounts for 7.1% of the total sample. Among them, papillary carcinoma was found in 6 cases (6.1%), and follicular carcinoma in 1 case (1%). The remaining 91 cases (92.9%) were benign findings, indicating a high frequency of benign changes in cold nodules.

DISCUSSION

This study analyzed data from 98 patients with thyroid cold nodules with the aim of determining the incidence of malignant changes and comparing diagnostic methods, including scintigraphy, ultrasound, cytological puncture and pathohistological processing. The results showed that the incidence of malignant changes was 7.1%, which is in line with previous studies that indicate a risk of malignancy in cold nodules between 5% and 15% (3,5,9). These findings confirm that although the majority of cold nodules

are benign in nature, there is always a clinically significant risk of malignancy, which is why a multi-stage diagnostic approach is needed.

The age distribution of the subjects in our study showed that the largest number of patients belonged to the older age group, especially the group between 60 and 79 years, which is in line with literature data indicating an increased incidence of thyroid disease in the elderly population (7,12). It is interesting that, although malignant findings were most common between the ages of 40 and 79, no significant association between age and the risk of malignancy was established. This suggests that although age may be a risk factor for the development of thyroid disease in general, it is not a sufficiently specific predictor of cold nodule malignancy by itself.

Analysis by gender showed a significantly higher prevalence of women (78.6%), which is consistent with global epidemiological trends according to which women have a higher predisposition to thyroid diseases, which is explained by hormonal factors, genetic predispositions

and environmental influences (1,4,13). Our results further highlighted that, although women more often had benign changes, men had a relatively higher proportion of malignant findings. This fact suggests that cold nodules in men may require a higher level of clinical suspicion and more careful diagnostic evaluation.

Regarding diagnostic methods, the results confirm the key role of scintigraphy, ultrasound and especially cytological puncture. Cytological diagnostics in our study showed high sensitivity (93%) and specificity (100%), which is in line with previous studies that state that FNA (fine needle aspiration) represents the gold standard in the initial evaluation of thyroid nodules (9,16). In parallel, ultrasound plays an irreplaceable role in assessing the morphological features of the nodules and in selecting lesions for puncture, while scintigraphy allows for the differentiation of cold from warm nodules and thus determines the indication for cytological work-up. Final confirmation of the diagnosis, as in other studies, was possible only by pathohistological analysis, which remains the ultimate diagnostic authority (5,16).

The most common malignant type in our study was papillary carcinoma, which is consistent with the literature data describing it as the most common histological form of thyroid carcinoma (5). This concordance further confirms the consistency of our results with global trends and epidemiological data.

However, it is important to highlight the limitations of this study. This is a retrospective study with a limited number of subjects from a single clinical center, which may reduce the generalizability of the results to a wider population. Also, the analysis did not include all potential risk

factors, such as radiation exposure, dietary habits or family history, which could play a significant role in the occurrence of malignancy. Future studies with a larger number of patients, a multicenter approach and the inclusion of additional clinical and genetic parameters would enable a more comprehensive assessment of the risk and effectiveness of diagnostic methods.

Ultimately, the results of our study confirm that although the risk of malignancy in cold nodules is relatively low, the combination of scintigraphy, ultrasound and especially cytological puncture represents an optimal diagnostic approach. Special attention should be paid to men with cold nodules and the individualization of the diagnostic protocol according to the age and clinical characteristics of the patients. The systematic use of the above methods ensures timely detection of malignant lesions and optimizes the decision-making process in clinical practice.

CONCLUSION

Scintigraphy, ultrasound, and clinical examination are useful methods in the evaluation of thyroid cold nodules, but cytological puncture has been shown to be the most sensitive and specific in differentiating benign from malignant changes. In our study, the risk of malignancy was 7.1%, with papillary carcinomas being the most common form. Malignant findings were more common in men, while women had significantly more benign changes. The combination of multiple diagnostic methods remains the most reliable approach for the timely detection and treatment of malignant thyroid nodules.

LITERATURE

1. Pacini F, Schlumberger M, Dralle H, Elisei R, Smit JW, Wiersinga W. European consensus for the management of patients with differentiated thyroid carcinoma of the follicular epithelium. *Eur J Endocrinol*. 2006;154(6):787–803.
2. Mazzaferri EL. Management of a solitary thyroid nodule. *N Engl J Med*. 1993;328(8):553–9.
3. Hegedüs L. Clinical practice. The thyroid nodule. *N Engl J Med*. 2004;351(17):1764–71.
4. Frates MC, Benson CB, Charboneau JW, Cibas ES, Clark OH, Coleman BG, et al. Management of thyroid nodules detected at US: Society of Radiologists in Ultrasound consensus conference statement. *Radiology*. 2005;237(3):794–800.
5. Gharib H, Papini E, Garber JR, Duick DS, Harrell RM, Hegedus L, et al. American Association of Clinical Endocrinologists, Associazione Medici Endocrinologi, and European Thyroid Association Medical Guidelines for Clinical Practice for the Diagnosis and Management of Thyroid Nodules. *Endocr Pract*. 2016;22(5):622–39.
6. Sisson JC, Freitas J, McDougall IR, et al. Radiation Safety in the Treatment of Patients with Thyroid Diseases by Radioiodine ¹³¹I: Practice Recommendations of the American Thyroid Association. *Thyroid*. 2011;21(4):335–46.
7. Hegedüs L, Bonnema SJ, Bennedbæk FN. Management of simple nodular goiter: current status and future perspectives. *Endocr Rev*. 2003;24(1):102–32.
8. Mazzaferri EL, Jhiang SM. Long-term impact of initial surgical and medical therapy on papillary and follicular thyroid cancer. *Am J Med*. 1994;97(5):418–28.
9. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, et al. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer. *Thyroid*. 2016;26(1):1–133.
10. Moon WJ, Jung SL, Lee JH, Na DG, Baek JH, Lee YH, et al. Benign and malignant thyroid nodules: US differentiation—multicenter retrospective study. *Radiology*. 2008;247(3):762–70.
11. Cooper DS, Doherty GM, Haugen BR, Kloos RT, Lee SL, Mandel SJ, et al. Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer. *Thyroid*. 2009;19(11):1167–214.
12. Kusic Z, Becker DV, Saenger EL, et al. Comparison of thyroid scintigraphy and ultrasonography in the diagnosis of thyroid nodules. *Clin Nucl Med*. 1992;17(2):89–93.
13. Kim EK, Park CS, Chung WY, Oh KK, Kim DI, Lee JT, et al. New sonographic criteria for recommending fine-needle aspiration biopsy of nonpalpable solid nodules of the thyroid. *AJR Am J Roentgenol*. 2002;178(3):687–91.
14. Cibas ES, Ali SZ. The Bethesda System for Reporting Thyroid Cytopathology. *Am J Clin Pathol*. 2009;132(5):658–65.
15. Baloch ZW, LiVolsi VA. Fine-needle aspiration of thyroid nodules: past, present, and future. *Endocr Pract*. 2004;10(3):234–41.
16. Baloch ZW, Livolsi VA. Follicular-patterned lesions of the thyroid: the bane of the pathologist. *Am J Clin Pathol*. 2002;117(1):143–50.

17. Wang CC, Friedman L, Kennedy GC, Wang H, Kebebew E, Steward DL, et al. A large multicenter correlation study of thyroid nodule cytopathology and histopathology. *Thyroid*. 2011;21(3):243–51.

18. Ghossein RA, Livolsi VA. Papillary thyroid carcinoma tall cell variant. *Thyroid*. 2008;18(11):1179–81.

SCINTIGRAFIJA ŠTITNJAČE. POJAVNOST KARCINOMA ŠTITNJAČE U HLADNOM ČVORU

Marko Krpan^{ID}, Bruno Rajič^{ID}, Marin Brajković^{ID}
Sveučilišna klinička bolnica Mostar, 88000 Mostar, Bosna i Hercegovina

SAŽETAK

Uvod: Karcinom štitnjače predstavlja jednu od najčešćih malignih bolesti endokrinog sustava, a njegove promjene često su asimptomatske u početnim stadijima. Hladni čvorovi štitnjače su često suspekt i zahtijevaju daljnje dijagnostičko ispitivanje kako bi se isključio maligni karakter. Dijagnostičke metode poput scintigrafije, ultrazvuka, citološke punkcije i patohistološke analize ključne su za pravilno razlučivanje benignih i malignih lezija. Ovaj rad bavi se analizom incidencije karcinoma štitnjače u bolesnika s hladnim čvorovima, s ciljem procjene efikasnosti različitih dijagnostičkih metoda u otkrivanju malignih promjena.

Cilj: Procijeniti pojavnost karcinoma štitnjače u scintigrafski dokazanom hladnom čvoru.

Ispitanici i metode: U istraživanju je sudjelovalo 98 bolesnika koji su u razdoblju od 2023.-2024. godine podvrgnuti scintigrafiji štitnjače zbog sumnje na hladni čvor. U svim slučajevima provedeni su dodatni dijagnostički postupci: ultrazvučni pregled, aspiracijska citološka punkcija i patohistološka analiza uzoraka tkiva. Analizirani su dob, spol, te dijagnostičke metode za utvrđivanje prirode čvora.

Rezultati: Od 98 pacijenata, najviše bolesnika bilo je u dobi između 60 i 79 godina (43 %). Žene su činile 78,6 % ispitanika. Rezultati su pokazali da je maligni karcinom štitnjače dijagnosticiran u 7,1 % ispitanika. Citološka punkcija pokazala je visoku osjetljivost (93 %) i specifičnost (100 %) u dijagnosticiranju benignih i malignih lezija. Najčešći benigni nalaz bio je folikularni adenom, dok su maligne promjene bile najčešće papilarni karcinomi.

Zaključak: Scintigrafija, ultrazvuk i citološka punkcija ključne su metode u evaluaciji hladnih čvorova štitnjače, pri čemu je citološka punkcija najosjetljivija za razlikovanje benignih od malignih lezija. Rizik malignosti u ovom istraživanju iznosio je 7,1 %, s većim udjelom u muškaraca.

Ključne riječi: karcinom štitnjače, hladni čvor, scintigrafija

Autor za korespondenciju: Marko Krpan, mag. rad. teh.; marko.krpanb@gmail.com

DIETARY HABITS OF PHYSIOTHERAPISTS

Vedrana Grbavac^{1,2}, Marija Mandić¹, Marija Govorko³, Vinka Lučić⁴, Nikolina Slišković¹

¹Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia and Herzegovina

²University Clinical Hospital Mostar, 88 000 Mostar, Bosnia and Herzegovina

³Department of Clinical Nursing, University of Dubrovnik, 20 000 Dubrovnik, Croatia

⁴University Department of Health Studies, University of Split, 21 000 Split, Croatia

Received on 20.10.2025.

Reviewed on 27.10.2025.

Accepted on 10.11.2025.



ABSTRACT

Introduction: Dietary habits, influenced by regional, cultural, and lifestyle factors, are crucial in maintaining physical and mental health. Healthy eating is often challenging in modern society, where sedentary lifestyles and processed food consumption prevail. Physiotherapists, as healthcare professionals, should set an example in adopting and promoting healthy dietary habits. However, research indicates that they do not always adhere to recommended nutritional guidelines, which may affect their health and professional performance.

Aim: To analyze the dietary habits of physiotherapists and their impact on health and professional efficiency.

Subjects and Methods: A cross-sectional study was conducted at the Faculty of Health Studies, University of Mostar, involving physiotherapists with at least a bachelor's degree. Data were collected via an anonymous online survey using a modified Food Frequency Questionnaire (FFQ). The study examined the frequency of food consumption, intake of sugar and salt, and habits related to fast food, snacks, and alcohol consumption.

Results: Most physiotherapists regularly consumed breakfast (79%), lunch (95%), and dinner (84%), while 61% had snacks. A significant number added sugar to beverages, while salt intake showed no gender differences. Fruit and vegetable consumption was below recommended levels, but cooked meals were preferred, and water intake was adequate. Male participants consumed more beer, while smoking was reported by 22% of respondents.

Conclusion: Although physiotherapists show awareness of healthy eating, improvements are needed, particularly in increasing fruit, vegetable, and fish intake. Nutritional education could enhance their overall health and professional effectiveness.

Keywords: dietary habits, healthy eating, physiotherapists

Corresponding author: Marija Mandić, Master of Physical Therapy;

marija.mandic@fzs.sum.ba

INTRODUCTION

Dietary habits, shaped by regional, cultural, historical, and production factors, have a significant impact on physical and mental health (1). In modern society, where sedentary lifestyles and consumption of processed foods are prevalent, proper nutrition becomes a challenge (2). Unhealthy eating patterns are associated with serious health problems such as obesity, diabetes, heart disease, and cancer, which can lead to premature mortality (3). Physical activity, essential for maintaining health, has a major impact on reducing these risks, but despite its importance, many people face low levels of physical activity, which further exacerbate the effects of poor nutrition (4, 5).

Healthcare professionals, such as physiotherapists, are particularly important in promoting healthy lifestyle habits, including proper nutrition and regular physical activity (6). As professionals involved in rehabilitation and improving body functionality, physiotherapists should be role models in adopting healthy eating habits (6, 7). However, despite their education in physical health, research suggests that physiotherapists are not always consistent in applying healthy eating guidelines in their own lives, which can negatively affect their performance in the professional environment, as well as their general health (8). Considering the importance of nutrition in the rehabilitation process, it is necessary to investigate what the barriers are to adopting healthy eating habits among physiotherapists and how these habits can be improved (9).

Nutrition and physical activity are the foundation of a healthy life, and their balance is essential for maintaining physical and mental health (10). In modern

society, which faces challenges such as rapid urbanization and the availability of processed foods, many people are overweight while at the same time suffering from malnutrition in terms of nutrients (11). In addition, a fast-paced lifestyle and reduced physical activity have become common problems that further worsen the condition (12). According to the World Health Organization, lack of physical activity and unhealthy diet are major risk factors for many chronic diseases, including cardiovascular diseases, type 2 diabetes, and cancer (13). Physiotherapists play a key role in promoting physical activity and health, and their role in educating patients about the importance of proper nutrition and physical activity can significantly contribute to the prevention of these diseases (14). Healthy eating models, such as the Food Guide Pyramid and the Healthy Eating Plate, provide guidelines for a balanced diet (15, 16). The pyramid arranges foods in order of importance, with vegetables, fruit, and whole grains forming the base, while dairy products, fish, eggs, and lean meat are consumed in moderation (15). Processed foods and red meat are at the top and are recommended to be consumed in moderation. The Healthy Eating Plate emphasizes a practical approach to meals: half of the plate should be filled with vegetables and fruit, while the other half contains whole grains and protein sources (16). It is recommended to drink water instead of sugary drinks and to use healthy fats, such as olive oil.

Physiotherapists, as experts dealing with functional movement and rehabilitation, should promote health and good lifestyle habits (17). Although physiotherapists are not nutritionists and cannot create diet therapy plans, they play an important role

in educating patients about the basics of healthy eating, which can positively influence the success of rehabilitation processes (18). Given that proper nutrition can directly affect various aspects of rehabilitation, including speed of recovery and reduction of risk of complications, physical therapists must be aware of the importance of this component of health (19). Despite their knowledge and skills in rehabilitation and physical therapy, physical therapists often do not apply the same principles in their own lives, which can have negative consequences on their ability to optimally perform their profession. Understanding the factors that shape dietary habits, as well as implementing strategies to promote healthy lifestyle habits among physical therapists (18, 19), is essential for improving general health, professional performance, and quality of patient care. Through education, support, and adaptation of working conditions, physiotherapists can become key actors in prevention, which has long-term benefits for the community and the healthcare system (19, 20).

AIM

The aim of this study is to systematically investigate the dietary habits of physiotherapists, with particular attention to their typical food patterns.

MATERIALS AND METHODS

The study was conducted from June to October 2024 at the Faculty of Health Studies, University of Mostar. A total of 100 physiotherapists participated in the study. The inclusion criteria in the study included physiotherapists with at least a completed undergraduate degree in physiotherapy and their voluntary decision to participate in the study. The exclusion

criteria were incomplete questionnaires or incomplete data, which ensured the quality and validity of the collected data.

The study was conducted via a survey using the Google Forms platform. The survey questionnaire referred to questions related to the dietary habits of physiotherapists. Dietary habits questionnaire - An adapted Food Frequency Questionnaire (FFQ) was used, which was based on the Spanish dietary questionnaire, but was adapted for the specific dietary habits of the local population and translated into Croatian. The questionnaire included questions about the frequency of consumption of different types of foods, including fruits, vegetables, meat, sweets, dairy products and cereals. Specific questions were also included regarding the preferences of certain foods among physiotherapists (21).

Respondents were sent a link to an online survey that was created via the Google Forms platform via their official e-mail addresses, collected through groups of physiotherapists on social networks. Respondents were informed about the aim of the research, and participation in the survey was voluntary and anonymous. At the beginning of the survey, the participants were informed about the purpose of the research and gave their consent to participate. The data was automatically collected through the Google Forms platform and then exported to Excel format for further processing and analysis. The research was approved by the Ethics Committee of the Faculty of Health Studies, University of Mostar.

The normality of the distribution of the results on the variables was examined using the Kolmogorov-Smirnov test. Descriptive statistics presented the results through the arithmetic mean (for a normal

distribution) and standard deviation or median and semi-interquartile scatter in the case of a distribution that deviates from normal. The Chi-square test and the Mann-Whitney U test were used to examine differences between groups, while the significance level was set at $p < 0.05$.

RESULTS

The tested sample consists of 100 physiotherapists, of whom there are significantly more female respondents (73%) compared to men, of whom only 27% are in the sample ($X^2 = 21.160$, $df = 1$, $p < 0.001$). The youngest respondent was 21 years old, the oldest 35, while the average age of the respondents, expressed over the median, was 24 years ($Q = 3$) in Table 1.

Table 1. Demographic and Statistical Data of Respondents

Data	Value
Total number of respondents	100
Number of female respondents	73% (73 female)
Number of male respondents	27% (27 male)
Statistical test (X^2)	21.160
Degrees of freedom (df)	1
P-value	< 0.001
Youngest respondent	21 years old
Oldest respondent	35 years old
Average age (median)	24 years old
Interquartile range (Q)	3

The basic descriptive parameters for height, weight, and BMI are shown in Table 2. The minimum body weight of the subjects was 49 kg, while the heaviest subject weighed 120 kg. The average Body Mass Index (BMI) was 24.072, which is the upper average of the recommended BMI, but still within the recommended limits according to the WHO classification, and the maximum was a high 39.18. The average weight of men was 89.5 kg, while for women it was 66.4 kg. The minimum

BMI for men in this study was 22.16, which means that there is not a single man with a below-average BMI, or underweight, while the average is slightly higher at 26.419, which belongs to the category of overweight, or excessive body weight. An analysis of women's minimum BMI shows that the lowest (16.91) was recorded in the malnutrition category, but that the average BMI of women belongs to the normal body weight category.

Table 2. Descriptive parameters for height, weight and BMI of physiotherapists ($N=100$)

	All participants				Male participants			Female participants				
	Min	Max	M	Sd	Min	Max	M	Sd	Min	Max	M	Sd
Body height (cm)	155	197	173,1	9,085	163	197	183,89	6,88	155	182	169,11	6,05
Body weight (kg)	49	120	72,636	15,72	61,1	118	89,503	11,379	49	120	66,397	12,12
BMI	16,91	39,18	24,072	3,843	22,16	30,68	26,419	2,592	16,91	39,18	23,204	3,879

Using the Chi-square test, it was determined that there are significantly more physiotherapists who consume breakfast (79%), lunch (95%), and dinner (84%) compared to those who do not, with the analysis of percentages showing that the lowest proportion of those who

consume breakfast every day is those who eat lunch every day, i.e., do not skip lunch. Statistically significantly more physiotherapists consume snacks compared to those who do not, while there are no differences in the frequency of use of dietary supplements (Table 3).

Table 3. Distribution of physiotherapists with regard to meal consumption ($N = 100$)

		Yes	No	X^2	df	p
		f (%)	f (%)			
Meal	Breakfast	79 (79 %)	21 (21 %)	33,640	1	< 0,001
	Lunch	95 (95 %)	5 (5 %)	81	1	< 0,001
	Dinner	84 (84 %)	16 (16 %)	46,24	1	< 0,001
	Snack	61 (61 %)	39 (39 %)	4,84	1	0,028
	Dietary supplements (vitamins, multivitamins, probiotics, sports nutrition)	43 (43 %)	57 (57 %)	1,96	1	0,162

No statistically significant differences were found in the habits of adding salt to already prepared food according to gender ($X^2 = 0.036$, $df = 1$, $p = 0.849$) and in adding

sugar between male and female physiotherapists ($X^2 = 0.461$, $df = 1$, $p = 0.497$, Table 4).

Table 4. Frequency of adding salt and sugar to food/beverages

Consumption habits	Males participants			Females participants			All participants		
	X^2	df	p	X^2	df	p	X^2	df	p
Putting salt in food	0,036	1	0,849	0,036	1	0,849	0,64	1	0,424
Putting sugar in drinks	0,461	1	0,497	0,461	1	0,497	4,84	1	0,028

An equal proportion of respondents added and did not add salt to already prepared food ($X^2 = 0.64$, $df = 1$, $p = 0.424$), but it was found that in the case of sugar, the proportion of respondents who added sugar to drinks was statistically significantly higher than that of those who did not ($X^2 = 4.84$, $df = 1$, $p = 0.028$).

Considering smoking habits, the most represented physiotherapists in the study were non-smokers (78%), compared to a statistically significantly lower proportion

of those who smoked, which was 22% ($X^2 = 213.2$, $df = 4$, $p < 0.001$). Among respondents who were smokers, the least, or only 2%, were those who smoked 20 or more cigarettes per day. No statistically significant gender difference was found in smoking habits ($X^2 = 1.893$, $df = 3$, $p = 0.64$); that is, male and female physiotherapists in this study do not differ significantly in terms of smoking habits (Table 5).

Table 5. Distribution of physiotherapists according to smoking habits ($N = 100$)

Data	Value
Total number of respondents	100
Percentage of non-smokers	78
Percentage of smokers	22
Percentage of smokers who smoke 20 or more cigarettes per day	2
Statistical test (X^2)	213.2
Degrees of freedom	4
P-value (smokers vs non-smokers)	<0.001
Statistical significance of gender differences in smoking habits	No significant difference ($X^2 = 1,893$)
P-value (gender and smoking habits)	0.64

The analysis of dietary habits of physiotherapists in Table 6 showed that there are no significant gender differences in the consumption of most foods ($p > 0.05$), except for marmalade/jam ($p =$

0.004) and beer ($p = 0.002$). Men and women equally often consume bread, snacks, sweets, and fast food, while men drink more beer.

Table 6. Combined table of consumption of different foods

Category	Foodstuff	1-3 times a week		4-6 times a week		1 time every day		Multiple times a day		X^2	p
		M	F	M	F	M	F	M	F		
Bread and bakery products	Croissant, doughnut, bakery product	15	55	5	11	2	2	0	2	8,178	0,085
	Wholemeal bread, wholemeal pastries	15	37	3	16	2	9	1	2	3,083	0,544
	Muesli, cereal flakes	14	44	4	11	4	7	0	2	2,01	0,745
	White bread	18	42	7	15	5	10	2	5	5,632	0,228
Salty snacks	Chips, snacks, popcorn	18	52	2	10	2	5	0	1	3,701	0,459
Sweets	Chocolate, chocolate cookies	11	39	8	19	2	6	1	5	4,466	0,345
	Pastries	14	46	7	15	2	4	0	2	2,43	0,675
	Marmalade or jam	15	61	4	3	4	1	0	3	13,226	0,004
Fast food	Burgers	17	52	4	8	2	4	1	0	3,318	0,526
	Pizza	14	54	5	10	1	3	1	1	6,836	0,109
Alcohol	Beer	12	56	9	5	2	2	0	0	13,068	0,002
	Wine	16	56	4	5	3	2	0	0	5,065	0,15
	Liquor, spirits	18	53	2	8	2	1	0	0	2,828	0,431

Analysis of physiotherapists' dietary habits showed that there were no statistically significant gender differences in the consumption of most foods ($p > 0.05$), except for fruit juices ($p = 0.015$). Intake of

dairy products, meat, fish, vegetables, and nuts was similar between the sexes, while men consumed fruit juices slightly more often (Table 7).

Table 7. Combined table of dietary habits of physiotherapists

Category	Foodstuff	1-3 times a week		4-6 times a week		1 time every day		Multiple times a day		X ²	P
		M	F	M	F	M	F	M	F		
Milk and dairy products	Yogurt and similar products	7	25	12	26	3	14	0	2	3,736	0,419
	Butter or margarine spread	13	50	6	11	2	4	0	2	5,970	0,191
	Milk, cocoa, white coffee	9	28	3	14	9	19	2	9	4,512	0,336
Meat, meat products and eggs	Fried/boiled egg	11	29	11	21	4	15	1	6	1,947	0,747
	Beef, roasted pork	14	50	6	14	6	5	0	2	5,634	0,188
Bluefish and tuna	Fried or baked blue fish	16	52	5	9	2	4	0	1	2,462	0,726
	Tuna and tuna dishes	17	45	2	17	4	2	0	1	7,645	0,075
Vegetables	Boiled potatoes, mashed	16	40	4	23	3	6	1	1	5,067	0,249
	Fried/baked potatoes	14	46	6	19	3	4	1	1	4,206	0,34
	Salad, green leafy vegetables	13	31	6	22	2	12	3	2	4,501	0,336
Fruits	Apple, pear, banana	10	27	7	21	3	17	2	4	5,176	0,253
	Orange, tangerine	15	28	3	17	3	6	0	3	3,703	0,432
Nuts	Almonds, hazelnuts, walnuts	12	37	4	17	4	6	1	6	4,455	0,346
	Peanuts, pistachios	13	45	4	11	2	7	2	3	3,77	0,437
Cooked dishes	Soup (meat or vegetable)	14	34	6	29	4	7	0	1	5,535	0,205
	Risotto with meat	17	44	2	14	3	5	0	2	3,576	0,46
Soft drinks	Carbonated drinks, Coca-Cola, Fanta	14	48	6	13	2	6	0	1	3,98	0,416
	Coffee	4	20	8	12	9	24	2	14	7,95	0,093
	Fruit juice (purchased or squeezed fruit)	10	44	8	20	2	6	2	0	10,99	0,015

DISCUSSION

Physiotherapists' dietary habits have a significant impact on their health and professional performance, as they are role models for their patients as health professionals. The results of the study show that 65% of the respondents have a normal body weight, while 2% are underweight, 23% are overweight, and 10% are obese. The statistically significant difference in body mass index (BMI) between men and women confirms the known trend that men, due to their specific body structure and fat distribution, tend to have a higher BMI (17). These data indicate the need for targeted interventions to reduce the proportion of overweight and undernourished individuals, especially in the context of the global obesity epidemic. According to the World Health Organization (WHO) guidelines, the recommended daily salt intake should not exceed 5 g (22). The results of the study show that an equal number of respondents add and do not add salt to ready-made

food, while in the case of sugar, a significantly higher proportion of respondents add it to drinks. These data are comparable to the findings of similar studies conducted on healthcare workers, where 24.8% of respondents stated that they never add salt to ready-made food, 56.9% do so only when it is not salty enough, while 20% of respondents add it almost always (23). Analyzing the frequency of consumption of bread, bakery products, cereals and processed foods during a week, no difference was observed between the sexes, except for the consumption of cereals. Namely, 38.1% of male physiotherapists consume this food four to six times a week, while only 12.5% of female respondents do the same. This difference may be related to the greater involvement of male physiotherapists in sports activities that require quick energy sources (18, 19). Furthermore, healthcare professionals consume white bread more often than wholemeal bread, which has been confirmed in other studies conducted

in this region (24, 25). For example, a study conducted in Serbia showed that white bread was the most frequently consumed food by 55% of respondents, and it was additionally found that the level of education did not influence the choice of nutritionally better types of bread (25).

The recommendation for fruit and vegetable consumption is at least five servings per day, with the aim of ensuring an adequate intake of vitamins and minerals necessary for proper body function (5, 13). In contrast, the results of this study indicate a significantly lower consumption of fruit and vegetables among physiotherapists ($p < 0.001$), which is not in line with the recommended guidelines. Previous studies have shown that entry into higher education often leads to changes in dietary habits, including a decrease in fruit and vegetable intake (26, 27), which may have long-term consequences on dietary patterns in adulthood. However, the results of the study indicate that the subjects consume bananas in larger quantities than recommended, while the intake of green leafy vegetables is inadequate, regardless of gender.

Meat is an important source of high-quality protein, vitamin B12, and iron, which are essential for muscle growth, energy maintenance, and nervous system function. Research results indicate that men consume chicken, turkey, ham, salami, and sausages significantly more often than women ($p < 0.001$), with the amounts consumed often exceeding the recommended values, while similar studies have shown insufficient intake of meat and fish (5). Furthermore, fish and tuna intake is similar between genders, but the majority of respondents consume less than the recommended amount, thereby reducing the intake of omega-3 fatty acids

that are essential for cardiovascular health (28). Intake of milk and dairy products, which are essential for osteoporosis prevention, also varies among respondents and is often not in line with the recommended values. Previous studies have shown that yogurt consumption can improve the quality of life of healthcare workers by positively affecting sleep and gastrointestinal health, which may contribute to their professional effectiveness (29, 30). Furthermore, the study shows that the diet of physiotherapists is not sufficiently represented by cooked food ($p < 0.001$), while the consumption of snacks is more frequent but in smaller quantities, similar to the results of other studies with healthcare professionals (24, 25). Analyzing alcohol consumption habits, previous studies conducted on the student population showed that 97.4% of women and 86.7% of men consume alcohol (31). The results of this study indicate that male physiotherapists consume beer more often and in larger quantities than recommended, while the total amounts of alcohol consumed by most respondents are lower than recommended values ($p < 0.001$). Although this can be considered positive, it is important to emphasize that the frequency and amount of alcohol consumption can pose a significant health risk. It was also shown that 78% of respondents do not smoke, which is in line with the results of studies conducted on healthcare professionals in the USA (2%), Australia (3%), and England (3%) (32).

Based on the overall results of the study, which indicate inadequate consumption of fruits, vegetables and fish, it can be concluded that there is a need for additional education of physiotherapists on proper nutrition. These results are in line

with previous research conducted on physiotherapy students, who did not meet the principles of healthy eating according to the guidelines and highlighted the need to increase nutritional awareness in order to encourage the adoption of healthier eating habits (33). Although some positive aspects of nutrition, such as more frequent consumption of cooked meals and sufficient water intake, indicate awareness of a healthy lifestyle, it is necessary to emphasize the limitations of the study, primarily the small sample of respondents, which may affect the generalizability of the results. Also, the survey method may be subject to subjective bias of the respondents. Future research should focus on evaluating the impact of educational programs aimed at improving the nutritional and physical habits of physiotherapists and examining the impact of such interventions on professional effectiveness.

CONCLUSION

The study showed that the dietary habits of physiotherapists are not fully aligned with the recommended dietary guidelines. Although the majority of respondents regularly consume main meals, the intake of fruits, vegetables, and fish remains below optimal levels, which may have long-term implications for their health and professional performance. The results show gender differences in dietary patterns, with men consuming more processed meat and beer, while women prefer dairy products and whole meal bread. Given the key role of proper nutrition in the prevention of chronic diseases and maintaining optimal physical fitness, it is necessary to implement targeted educational programs to improve nutritional awareness and practice among

physiotherapists. Future research should focus on evaluating the effectiveness of nutritional education and developing strategies for implementing healthier eating habits in this professional group.

LITERATURE

1. Cao C, Xiao Z, Wu Y, Ge C. Diet and Skin Aging-From the Perspective of Food Nutrition. *Nutrients*. 2020;12(3):870. doi: 10.3390/nu12030870.
2. Huse O, Schultz S, Boelsen-Robinson T, Ananthapavan J, Peeters A, Sacks G, et al. The implementation and effectiveness of outlet-level healthy food and beverage accreditation schemes: A systematic review. *Obes Rev*. 2023;24(4):13556. doi: 10.1111/obr.13556.
3. Milanović Z, Sporiš G, Trajković N, Vračan D, Andrijašević M, Pantelić S, et al. Attitudes towards exercise and the physical exercise habits of University of Zagreb students. *Annales Kinesiologiae*. 2013;4(1):57-70.
4. Babić M. U zdravom tijelu zdrav duh: tjelovježbom do boljeg zdravlja. *Zdravstveni glasnik*. 2022;8(1):84-93. doi: 10.47960/2303-8616.2022.15.84.
5. Salibašić A. Prehrambene navike fizioterapeuta (doctoral thesis). University of Rijeka. Faculty of Health Studies. Available at: <https://urn.nsk.hr/urn:nbn:hr:184:944691>.
6. Stollar E, Smith D. Uncovering protein structure. *Essays Biochem*. 2020;64(4):649-680.
7. Poole R, Kennedy O, Roderick J, Fallowfield P, Hayes J, Parkes J. Coffee consumption and health: umbrella review of meta-analyses of multiple health outcomes. *British Medical Journal*. 2017;359:5024.
8. Kgokong D, Parker R. Physical activity in physiotherapy students: Levels of

- physical activity and perceived benefits and barriers to exercise. *S Afr J Physiother*. 2020;76(1):1399. doi: 10.4102/sajp.v76i1.1399.
9. Morris DM, Kitchin EM, Clark DE. Strategies for optimizing nutrition and weight reduction in physical therapy practice: the evidence. *Physiother Theory Pract*. 2009;25(5-6):408-23. doi: 10.1080/0959398090283536.
10. Netzer R, Elboim-Gabyzon M. Attitudes toward the integration of nutritional assessment and counseling in the framework of physical therapy: a cross-sectional survey. *BMC Med Educ*. 2023;23(1):802. doi: 10.1186/s12909-023-04706-2.
11. Vukić I, Pravdić D. Važnost pravilne prehrane osoba oboljelih od šećerne bolesti. *Zdravstveni glasnik*. 2020;6(1):72-82. doi: 10.47960/2303-8616.2020.11.71.
12. Jakicic J, Kraus W, Powell K, Campbell W, Janz K, Troiano R, et al. Association between bout duration of physical activity and health: systematic review. *Med Sci Sports Exerc*. 2019;51(6):1213-9.
13. World Health Organization. Global atlas on cardiovascular disease prevention and control. Geneva: World Health Organization; 2011.
14. Jones CA, Forhan M. Addressing weight bias and stigma of obesity amongst physiotherapists. *Physiother Theory Pract*. 2021;37(7):808-816. doi: 10.1080/09593985.2019.1648623.
15. Mandić ML. Znanost o prehrani : hrana i prehrana u čuvanju zdravlja. [Internet]. Osijek: Prehrambeno tehnološki fakultet Osijek; 2004, [13.03.2025.] Available at: <https://urn.nsk.hr/urn:nbn:hr:109:175217>.
16. Verbanac D, Maleš Ž, Barišić K. Nutrition - facts and myths. *Acta Pharm*. 2019;69(4):497-510.
17. Lee DH, Keum N, Hu FB, Orav EJ, Rimm EB, Willett WC, Giovannucci EL. Predicted lean body mass, fat mass, and all cause and cause specific mortality in men: prospective US cohort study. *BMJ*. 2018;362:k2575. doi: 10.1136/bmj.k2575.
18. Rahmati-Najarkolaei F, Talatappeh H, Naghavi S. Physical activity and nutrition status in the university students: A mixed method study. *J Health Policy Sustainable Health*. 2015;2(2):201-206.
19. Kgekong D, Parker R. Physical activity in physiotherapy students: Levels of physical activity and perceived benefits and barriers to exercise. *S Afr J Physiother*. 2020;76(1):1399.
20. Schramlová M, Řasová K, Jonsdottir J, Pavlíková M, Rambousková J, Äijö M, et al. Quality of life and quality of education among physiotherapy students in Europe. *Front Med*. 2024;19(11):1344028.
21. Food Frequency Questionnaire [Internet]. Bethesda (MD): National Heart, Lung, and Blood Institute; 2018 [cited 2025 Mar 28]. Available from: <https://biolincc.nhlbi.nih.gov/frameoffspring/forms/>
22. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. *Lancet Glob Health*. 2018;6(10):e1077-e1086. doi: 10.1016/S2214-109X(18)30357-7.
23. Kwong EJJ, Whiting S, Bunge AC, Leven Y, Breda J, Rakovac I et al. Population-level salt intake in the WHO European Region in 2022: a systematic review. *Public Health Nutr*. 2023;26(S1):s6-s19. doi: 10.1017/S136898002200218X.
24. Magdelinić G, Magdelinić M, Marinović N, Živanović S, Ilić B. Dietary

habits among healthcare and education workers. *Pons Med*. 2019;16(1):19-23.

25. Šereš Z, Šoronja D, Grujičić M, Maravić N, Kiš F, Dokić LJ, et al. Bread as an indicator of changing dietary habits among young people. *Hrana u zdravlju i bolesti*, scientific-professional journal for nutrition and dietetics. 2017;6(2):48-89.

26. Hootman KC, Guertin KA, Cassano PA PhD. Longitudinal changes in anthropometry and body composition in university freshmen. *J Am Coll Health*. 2017;65(4):268-276. doi: 10.1080/07448481.2017.1280498.

27. Deforche B, Van Dyck D, Deliëns T, De Bourdeaudhuij I. Changes in weight, physical activity, sedentary behaviour and dietary intake during the transition to higher education: a prospective study. *Int J Behav Nutr Phys Act*. 2015;12:16. doi: 10.1186/s12966-015-0173-9.

28. Hu Y, Hu FB, Manson JE. Marine Omega-3 Supplementation and Cardiovascular Disease: An Updated Meta-Analysis of 13 Randomized Controlled Trials Involving 127 477 Participants. *J Am Heart Assoc*. 2019;8(19):e013543. doi: 10.1161/JAHA.119.013543.

29. Ratajczak AE, Zawada A, Rychter AM, Dobrowolska A, Krela-Kaźmierczak I. Milk and Dairy Products: Good or Bad

for Human Bone? Practical Dietary Recommendations for the Prevention and Management of Osteoporosis. *Nutrients*. 2021;13(4):1329. doi:

10.3390/nu13041329.

30. Kinoshita T, Maruyama K, Suyama K, Nishijima M, Akamatsu K, Jogamoto A, Katakami K, Saito I. Consumption of OLL1073R-1 yogurt improves psychological quality of life in women healthcare workers: secondary analysis of a randomized controlled trial. *BMC Gastroenterol*. 2021;21(1):237. doi: 10.1186/s12876-021-01793-7.

31. Giacometti J, Buretić Tomljanović A. Prevalence of dyslipidemia in the student population of the University of Rijeka. *Medicina Fluminensis*. 2013;49(2):184-192.

32. Smith DR, Leggat PA. An international review of tobacco smoking in the medical profession: 1974-2004. *BMC Public Health*. 2007;7:115. doi: 10.1186/1471-2458-7-115.

33. Szypowska A, Jeziorek M, Regulska-Illow B. Assessment of eating and lifestyle habits among Polish cosmetology and physiotherapy students. *Rocz Panstw Zakl Hig*. 2020;71(2):157-163. doi: 10.32394/rpzh.2020.0111.

PREHRAMBENE NAVIKE FIZIOTERAPEUTA

Vedrana Grbavac^{1,2}, Marija Mandić¹, Marija Govorko³, Vinka Lučić⁴, Nikolina Slišković¹

¹Fakultet zdravstvenih studija, Sveučilište u Mostaru, Mostar, Bosna i Hercegovina

²Sveučilišna klinička bolnica Mostar, 88 000 Mostar, Bosna i Hercegovina

³Studij kliničko sestrinstvo, Sveučilište u Dubrovniku, 20 000 Dubrovnik, Hrvatska

⁴Sveučilišni odjel zdravstvenih studija, Sveučilište u Splitu, 21 000 Split, Hrvatska

SAŽETAK

Uvod: Prehrambene navike, pod utjecajem regionalnih, kulturoloških i čimbenika stila života, ključne su u održavanju tjelesnog i mentalnog zdravlja. Zdrava prehrana često je izazov u modernom društvu, u kojem prevladavaju sjedilački način života i konzumacija prerađene hrane. Fizioterapeuti, kao zdravstveni djelatnici, trebali bi biti primjer u usvajanju i promicanju zdravih prehrambenih navika. Međutim, istraživanja pokazuju da se ne pridržavaju uvijek preporučenih prehrambenih smjernica, što može utjecati na njihovo zdravlje i profesionalnu izvedbu.

Cilj: Analizirati prehrambene navike fizioterapeuta i njihov utjecaj na zdravlje i profesionalnu učinkovitost.

Ispitanici i metode: Na Fakultetu zdravstvenih studija Sveučilišta u Mostaru provedeno je presječno istraživanje u kojem su sudjelovali fizioterapeuti s najmanje završenim preddiplomskim studijem. Podaci su prikupljeni putem anonimne ankete pomoću modificiranog Upitnika o učestalosti konzumiranja hrane (FFQ). Ispitana je učestalost konzumacije hrane, unos šećera i soli te navike vezane uz brzu hranu, grickalice i konzumaciju alkohola.

Rezultati: Većina fizioterapeuta redovito doručkuje (79%), ruča (95%) i večera (84%), dok 61% ima međuobroke. Značajan broj ispitanika dodaje šećer u pića, a unos soli nema razlike prema spolu. Konzumacija voća i povrća bila je ispod preporučenih razina, ali su se preferirala kuhana jela i unos vode je bio dovoljan. Muški sudionici konzumirali su više piva, a 22% ispitanika čine pušači.

Zaključak: Iako fizioterapeuti pokazuju svijest o zdravoj prehrani, potrebna su poboljšanja, posebice u povećanju unosa voća, povrća i ribe. Obrazovanje o prehrani moglo bi poboljšati njihovo cjelokupno zdravlje i profesionalnu učinkovitost.

Ključne riječi: prehrambene navike, zdrava prehrana, fizioterapeuti

Autor za korespondenciju: Marija Mandić, magistrica fizikalne terapije;

marija.mandic@fzs.sum.ba

THE ROLE OF MRI, MSCT AND PET/CT DIAGNOSTIC IMAGING IN THE FOLLOW-UP OF PATIENTS WITH METASTATIC BREAST CARCINOMA

Toni Džeba 

Faculty of Health Studies, University of Mostar, 88 000 Mostar, Bosnia and Herzegovina

Received on 20.5.2025.

Reviewed on 2.10.2025.

Accepted on 12.11.2025.



ABSTRACT

Introduction: Breast cancer is one of the most frequently diagnosed malignant diseases, and its incidence has been continuously increasing in the last few decades. It is the leading cause of cancer-related mortality in the female population. Despite advances in diagnostics and treatment, disease recurrence and metastatic form continue to represent a significant clinical challenge.

Materials and methods: A search of scientific literature was conducted in the PubMed database using the following keywords: radiology imaging, metastatic breast cancer, PET/CT, MRI and MSCT. Out of a total of 88 identified works, 21 were selected for detailed analysis according to the criteria of relevance, quality and availability.

Results: The analysis showed that MRI and PET/CT modalities are the most sensitive and specific in detecting breast cancer metastases, especially in the bones, liver and brain. MRI allows early detection of metastatic changes due to its high spatial resolution, while PET/CT provides additional metabolic information that complements the anatomical view. CT is a standard available modality, but with lower sensitivity in early detection of metastases.

Conclusion: The combination of different imaging methods (MRI + PET/CT) provides complementary information and increases diagnostic accuracy. The selection of the optimal modality should be individualized according to the type of cancer, the clinical picture and the availability of technology.

Keywords: breast, metastases, MRI, MSCT, PET/CT.

Corresponding author: Toni Džeba, Master of Radiological Technology;

toni.dzeba@gmail.com

INTRODUCTION

Breast cancer is the most common malignancy in women, both in Western Europe and in the United States. Its incidence peaks between the ages of 40 and 55, and its prevalence is still increasing (1). The disease behaves differently in different patients. Each patient has a different tumor behavior, different response to treatment, and an individual prognosis (2). Malignant neoplasms of the breast are among the leading causes of death in women in 2022, ranking seventh, while in the category of malignant diseases they are the first leading cause of death in women, followed by malignant neoplasms of the bronchi and lungs and malignant neoplasms of the colon (3). Due to the increasing incidence of breast cancer, it is estimated that mortality associated with breast cancer will increase by 43% globally from 2015 to 2030 (4). Despite great progress in surgical treatment, radiotherapy, and adjuvant chemotherapy protocols, tumor recurrence and metastasis remain the main problems in the treatment of breast cancer (1). Advanced breast cancer includes metastatic (MBC) and locally advanced breast cancer (LABC). MBC is still an incurable disease with a 5-year survival rate of between 15 and 27%, and progression to MBC occurs in approximately 20–30% of patients without metastases (5). Some studies have shown that approximately 4–10% of breast cancers have already metastasized at the time of diagnosis (4). The risk of recurrence and the different patterns of metastatic spread are not only influenced by the stage at initial presentation, but are also related to the molecular subtype of the primary tumor (6).

Aim of the literature review

The aim of this review is to analyze the existing imaging methods used in the diagnosis and staging of advanced breast cancer, with an emphasis on the role of CT, MRI, PET/CT, and hybrid techniques, in order to identify advantages, limitations, and optimal application protocols.

Research methodology

The literature review was performed by searching the PubMed database using the key terms: "radiology imaging", "metastatic breast cancer", "PET/CT", "MRI" and "MSCT". From a total of 88 papers identified, 21 papers were selected for detailed analysis based on the criteria of relevance, quality, content and availability with the aim of obtaining a comprehensive insight into current diagnostic practices and guidelines.

RESULTS

The analysis of 21 included studies showed that MRI and PET/CT modalities showed the highest sensitivity and specificity in detecting metastases in different sites, especially in the bones, liver and brain. MRI stands out for its high resolution and the possibility of early detection of metastatic changes before structural lesions develop, while PET/CT provides metabolic information that complements the anatomical view. CT remains the standard and widely available modality, but its sensitivity is lower compared to newer hybrid techniques.

WB-MRI and PET/MRI are particularly important, as they allow for a full-body examination in one step and show the potential to become the techniques of choice in the future. The combination of

modalities (e.g. MRI + PET/CT) increases the accuracy compared to individual methods. In conclusion, imaging methods should not be viewed competitively, but

rather as complementary, and their selection should be adjusted to the type of metastasis, the patient's clinical picture and the availability of equipment.

Table 1. *Characteristics of studies included in the final analysis*

Autor (year)	Study design	Diagnostic modality	Key findings
Pan et al. (2010)	Cohort	CT, PET/CT, MRI	Presentation of the effectiveness of different modalities in the detection of metastases in breast cancer
Lothar et al. (2023)	Review	CT, PET/CT, WB – MRI, DWI	A comprehensive overview of modern imaging methods in MBC
Lupichuk et al. (2020)	Cohort	CT, MRI	Excessive imaging in DCIS and early breast cancer, without clinical benefit
Pesapane et al. (2020)	Review	PET/CT, MRI, CT	Guidelines for optimal diagnosis of metastatic breast cancer
Zugni et al. (2018)	Prospective	WB - MRI	WB – MRI adds value in the assessment of advanced breast cancer
Gioia et al. (2015)	Cohort	WB - MRI	Early detection of metastatic disease in asymptomatic patients
Xia et al. (2023)	Meta - analysis	PET/CT, PET/MRI	PET/MRI equally or more sensitive than PET/CT for bone metastases
Gerke et al. (2024)	Systematic review and meta - analysis	PET/CT, NaF – PET/CT, MRI, CT, scintigraphy	MRI and PET/CT most sensitive and specific for bone metastases
Heindel et al. (2014)	Review	CT, MRI, PET/CT, scintigraphy	Presentation of the role of certain modalities in the detection of bone metastases
Cook (2022)	Review	PET/CT, scintigraphy	PET/CT recommended for early assessment of response to therapy of bone metastases
Haug et al. (2012)	Cohort	PET/CT	PET/CT as a predictor of survival after radioembolization of liver metastases
Barabasch et al. (2015)	Cohort	PET/CT, DWI - MRI	MRI superior to PET/CT in assessing early response of liver metastases
Lecouvet et al. (2024)	Review	WB – MRI	WB – MRI the future standard for metastatic disease and myeloma
Marino et al. (2020)	Review	CT, MRI, PET/CT	Analysis of diagnostic tools for lymph nodes in breast cancer
Morawitz et al. (2021)	Cohort	CT, MRI, PET/MRI	PET/MRI shows advantages in nodal staging compared to CT/MRI
Aktas et al. (2022)	Cohort	UZV, MRI, PET/CT	Combination of MRI + PET/CT improves diagnostic accuracy for lymph nodes
Fares et al. (2019)	Review	MRI, PET/CT	Barriers and innovations in clinical trials of brain metastases
Mohan et al. (2015)	Case report	MRI	Leptomeningeal metastases as the first presentation of breast cancer
Short et al. (2014)	Cohort	PET/CT	PET/CT can help detect leptomeningeal metastases
Shan et al. (2007)	Case report	PET/CT	FDG – PET/CT shows increased glucose uptake in leptomeningeal metastases
Constantinidou et al. (2011)	Retrospective	PET/CT	PET/CT useful in monitoring and determining the stage of recurrence/metastatic breast cancer

BONE METASTASES

The bone is the most common place where breast cancer cells appear. The presence of bone metastases can cause severe death (7). Research has shown that approximately 70% of breast cancer patients develop bone metastases after a certain time. Current National Comprehensive Cancer Network (NCCN) clinical guidelines recommend consideration of additional imaging with

computed tomography (CT) and skeletal scintigraphy in patients with stage I–III invasive breast cancer. CT according to the onco protocol, skeletal scintigraphy and magnetic resonance (MR) are also recommended for invasive breast cancer in stage IV, while 18F fluorodeoxyglucose (FDG) positron emission tomography - computed tomography (PET/CT) is recommended as an additional modality exclusively for patients in whom there is a

certain risk or suspicion of distant metastases (8).

The largest number of bone metastases behave osteolytically. Approximately 15 – 20% of patients develop osteoblastic metastases. Osteoblastic metastases are very easily detected on CT scans, unlike lytic metastases. They behave hypodensely on CT and are surrounded by bone marrow. For lytic metastases to be visible on CT, minimal cortical destruction is required, which can reduce the sensitivity of CT in early detection of metastases, since only the bone marrow is affected. A study by Yang et al. showed that CT is sensitive in 73% and specific in 95% of patients in detecting bone metastases. Other authors have conducted similar studies and all have reached the same or similar results (9). Magnetic resonance imaging (MRI), due to its high contrast between soft tissues and high spatial resolution, has the ability to detect metastases before any changes in the internal structure of the bone occur that would then be visible on other diagnostic modalities. Thanks to the discovery of new sequences, for example STIR, the need for the use of a contrast agent has been reduced, which then enables patients with impaired renal function to undergo one such imaging (9). In addition to standard morphological sequences including T1 and T2 weighted images and short recovery tau inversions, diffusion weighted images – DWI are now routine. The increase in water diffusion, which can be seen on ADC maps, is the result of the cytotoxic effect of the therapy, which causes a decrease in the integrity of the cell membrane (10). In the aforementioned meta-analysis, the aforementioned research by Yang et al. it was concluded that MR is

91% sensitive and 95% specific in diagnosing bone metastases. Therefore, it is superior to both CT and bone scintigraphy and about as good as PET/CT. Further studies came to the same results, for example one that included only patients with breast cancer. Another meta-analysis showed that MRI and PET/CT were more than 80% sensitive and more than 90% specific for the detection of bone metastases (9). Bone metastases of ductal carcinoma origin are more sensitive to 18F-FDG PET/CT than lobular carcinoma. This is attributed to differences in cell density, proliferation rate, and GLUT1 expression. It has been previously known that sclerotic metastases are significantly less sensitive to 18F-FDG than lytic metastases. Since lobular carcinoma metastases are most often sclerotic, they are less frequently diagnosed with this imaging modality (10).

LIVER METASTASES

Despite advances in adjuvant treatment of breast cancer, approximately 20% of patients with initially local disease will still develop metastases involving the liver (11). Liver metastases are often routinely detected by ultrasound, contrast-enhanced CT, MRI, or PET/CT, but the question remains as to which is the most optimal way to monitor the effects of treatment on liver metastases. A study by Barabasch et al. showed that the accuracy between PET/CT and DWI-MR is not only comparable, but also significantly higher on MRI than on PET/CT alone. DWI-MR appears to be superior to PET/CT for early assessment of response to treatment in patients with liver metastases from common solid tumors (colorectal, breast) (12). Liver metastases are visualized as

areas of hyperintense signal on DWI sequences. T2-weighted anatomical sequences are used to confirm their diagnosis. Studies conducted so far have shown that WB-MR is more sensitive in detecting visceral lesions compared to CT and FDG PET/CT (13).

LYMPH NODE METASTASES

Lymph nodes represent the first regional site of metastasis and it is very important to confirm or exclude metastatic sites in lymph nodes at the very beginning of treatment and determining the stage of the disease. This significantly affects the treatment plan and prognosis of the disease (14).

MRI does not have a great diagnostic value in the analysis of lymph nodes. The main reason for this is that the breast coil does not sufficiently cover the axillary area, as well as physiological movements (breathing, heartbeat, pulsations of large blood vessels, swallowing) all of which are movements that create artifacts. MRI allows to see cortical thickening, loss of fatty hilus and altered shape of the lymph node, but these features cannot confirm metastatic disease. Edema in the area around the lymph node, which appears as a hyperintense signal on T2 sequences, has been shown to have the highest predictive value for confirming malignancy (100%) among predefined quantitative and qualitative descriptors. After injection of contrast agent, the nodes enlarge rapidly and homogeneously with a characteristic signal intensity that is higher at the periphery of the node than at its center (edge enhancement). Modified axillary imaging protocols exist, but despite the fact that they can significantly increase the sensitivity and specificity of the

examination itself, they are rarely used in practice because they significantly prolong the scanning time (14).

A study by Cheung et al. demonstrated that CT has a sensitivity of 72, specificity of 40, and accuracy of 66.7% in detecting the presence of metastatic lymph nodes after patients received neoadjuvant chemotherapy. In their study, of 148 patients who underwent preoperative CT, 61 patients, or 41.2%, had a positive CT finding for lymph node metastases. The thickness of the lymph node cortex, which is most often analyzed, was significantly greater in metastatic lymph nodes (7.5–5.0 mm versus 2.6–2.8 mm; $p < 0.001$). Previous studies have confirmed that cortical thickness > 3 mm with a 95% confidence interval and loss of hilar fat are predictors of confirmation of a lymph node graft (14).

PET scanning, when used in combination with CT, is a very powerful tool in demonstrating advanced axillary disease and spread beyond the axilla. Studies have shown that the sensitivity in this case ranges from 80 to 94%, and the specificity is 86 to 90%. PET/CT saves patients from unnecessary and painful lymph node biopsies, allows for monitoring of patients before and after therapy, and leads to better treatment planning depending on whether the finding is positive or negative for metastatic disease. However, PET/CT is not yet sensitive enough to detect primary breast cancer or to assess axillary lymph nodes in early-stage breast cancer (stages I and II) (14). The literature shows that PET/CT can provide information on extraaxillary lymph node involvement better than conventional imaging methods and that the diagnosis of extraaxillary lymph node metastases by clinically well-

established methods shows a lack of sensitivity (15). Aktas et al. demonstrated that MRI had better accuracy than PET-CT. When the imaging modalities were used together, the accuracy rate was slightly better than when they were used separately (16).

PERITONEAL CARCINOMATOSIS

Regarding peritoneal carcinomatosis, CT is the most common imaging modality used to evaluate the peritoneum, but it requires intravenous contrast. For example, it has been reported that the sensitivity is only 25% for implants smaller than 0.5 cm compared with 90% for those larger than 5 cm. In contrast, MRI has been shown to be more accurate in detecting small peritoneal masses and carcinomatosis because of its superior soft tissue contrast and ability to provide additional information about tissue characteristics with the addition of dynamic contrast-enhanced imaging (2).

DWI sequences play an indispensable role in the analysis of peritoneal disease. Cianci et al. evaluated the sensitivity of DWI combined with MRI in detecting peritoneal carcinomatosis in 24 patients with malignancies and reported that DWI combined with MRI increased the sensitivity and detection of peritoneal carcinomatosis compared with MRI alone. In this setting, PET/CT with FDG radiopharmaceutical has a limited role and its main use would be to detect unsuspected extraperitoneal involvement (2).

BRAIN METASTASES

Breast cancer brain metastases most often occur at the gray-white matter junction or at the smooth edges of the brain. They may also present as small tumor foci with or

without extensive vasogenic edema, depending on tumor size (17).

MRI is the modality of choice for imaging the neurological system. Computed tomography (CT) scanning can be a useful diagnostic tool in acute situations to exclude hemorrhage and effusion; however, it lacks the resolution, coverage, and attention to detail offered by MRI. However, CT is widely available and its diagnostic results can be obtained quickly. Since the 1980s, contrast-enhanced MRI has become the modality of choice for imaging the brain and potential metastases. It is more sensitive than native MRI or CT in detecting lesions in patients suspected of having brain metastases. It also provides a better ability to distinguish metastatic brain changes from other neurological disorders that may be visible on MRI. Over time, as technology develops and the magnetic field becomes stronger, as well as the use of contrast agents, it is possible to detect metastases even when their size is less than 5 mm. Research shows that the time after the application of the contrast agent and the start of the scan can have a significant impact on the detection of metastatic lesions. Kushnirskz et al. found at least one additional lesion in 43% of patients after introducing a delay of 15 minutes (29). A limitation is that patients with implanted devices are a contraindication for undergoing MR and may have to settle for CT instead (17).

Positron emission tomography with computed tomography PET/CT provides metabolic information about metastatic changes in the brain to complement anatomical and physiological data collected by MR or CT. The problem occurs due to the high metabolic activity of the brain and the high consumption of

glucose, where a large amount of background signaling occurs. Also, after treatment, inflammatory changes occur around metastatic lesions that accumulate FDG and can give a false positive result for the presence of pathological changes. This results in an overestimation of the amount of tumor cells, which limits the ability of FDG-PET to detect smaller metastatic lesions. Image fusion with PET/CT scans combines information from two different modalities and interprets them in a single image. Combined PET/CT scans provide images that precisely determine the anatomical location of abnormal metabolic activity in the body (17).

LEPTOMENINGEAL METASTASES

Leptomeningeal metastases (LM) are rare complications of malignant disease and most commonly occur in patients diagnosed with primary breast cancer. In the literature, most cases describe LM carcinomatosis as a result of seeding of a solid primary tumor into the arachnoid mater and pia mater, either by hematogenous spread or directly through the cerebrospinal fluid. As a result, the entire neuroaxial system can be affected (18). Contrast-enhanced magnetic resonance imaging can detect meningeal involvement suggestive of LM before lumbar puncture (19). The gold standard for diagnosing this disease is MRI with intravenous contrast. The enlargement of the metastatic lesion is dramatic because even small nodular metastases grow vigorously and are easily detected on postcontrast T1-weighted sequences. If MRI is performed without contrast, metastatic lesions could easily be missed. Due to increased glycolysis and cellular

turnover, tumor cells increase glucose uptake. FDG studies use this property of malignant cells to help identify areas of increased metabolism, indirectly locating areas of metastasis. LM also retains this property (20).

CONCLUSION

By reviewing the literature on the topic "Role of MR, CT and PET/CT diagnostic imaging tests in the follow-up of patients with metastatic breast cancer" and analyzing 21 studies, the following key facts can be distinguished:

- CT is the most available and standardly used modality, but has a lower sensitivity in early detection of metastases.
- MRI shows the highest sensitivity and specificity in detecting metastases in bones, liver and brain; it allows for early recognition of changes.
- PET/CT provides additional metabolic information and improves treatment planning, especially in the detection of extraaxillary lymph nodes and assessment of response to treatment.
- WB-MRI presents new perspectives, allows for a full-body examination in one step and will potentially become the technique of choice in the future.
- The combination of different modalities (MRI + PET/CT) increases diagnostic accuracy compared to the use of only one method.
- The choice of diagnostic modality must be individualized according to the type of cancer, stage of the disease, patient age and availability of methods.

REFERENCES

1. Pan L, Han Y, Sun XG, Liu J, Gang H. J Cancer Res Clin Oncol. 2010;136:1007–1022.

2. Lothar D, Robert M, Elwood E, Smith S, Tunariu N, Johnston SRD, et al. Imaging in metastatic breast cancer, CT, PET/CT, MRI, WB – DWI, CCA: review and new perspectives. *Cancer Imaging*. 2023;23–53.
3. Lupichuk S, Tilley D, Surgeoner B, King K, Joy A. Unwarranted imaging for distant metastases in patients with newly diagnosed ductal carcinoma in situ and stage I and II breast cancer. *Research*. 2020;63(2):100-109.
4. Pesapane F, Downey K, Rotili A, Cassano E, Koh DM. Imaging diagnosis of metastatic breast cancer. *Insights into Imaging*. 2020;11:79.
5. Zugni F, Ruju F, Pricolo P, Alessi S, Iorfida M, Colleoni MA, et al. The added value of whole – body magnetic resonance imaging in the management of patients with advanced breast cancer. *PLoS ONE*. 2018;13(10):e0205251.
6. Gioia DD, Stieber P, Schmidt GP, Nagel D, Heinemann V, et al. Early detection of metastatic disease in asymptomatic breast cancer patients with whole – body imaging and defined tumour marker increase. *British Journal of Cancer*. 2015;112:809–818.
7. Xia L, Lai J, Huang D, Qui S, Luo Y, Cao J. Comparing the diagnostic efficacy of 18F FDG PET/CT and 18F FDG PET/MRI for detecting bone metastases in breast cancer: a meta – analysis. *Radiol Oncol*. 2023;57(3):299–309.
8. Gerke O, Nygaard ST, Sigaroudi VR, Vogsen M, Vach W, Hildebrandt MG, et al. Diagnosing Bone Metastases in Breast Cancer: A Systematic Review and Network Meta – Analysis on Diagnostic Test Accuracy Studies of 18F FDG – PET/CT, 18F-NaF-PET/CT, MRI, Contrast – Enhanced CT, and Bone Scintigraphy. *Elsevier*. 2024;0001–2998.
9. Heindel Q, Gubitz R, Vieth V, Weckesser M, Schober O, Schafers M. The Diagnostic Imaging of Bone Metastases. *Dtsch Arztebl Int*. 2014;111:741-7.
10. Cook GJR. Imaging of Bone Metastases in Breast Cancer. *Semin Nucl Med*. 2022;52(5): 531–541.
11. Haug AR, Donfack BPT, Trumm C, Zech CJ, Michl M, Laubender RP, et al. 18F – FDG PET/CT Predicts Survival After radioembolization of Hepatic Metastases from Breast Cancer. *J Nucl Med*. 2012;53:371-377.
12. Barabasch A, Kraemer NA, Ciritsis A, Hansen NL, Lierfeld M, Heinzl A, et al. Diagnostic Accuracy of Diffusion – Weighted Magnetic Resonance Imaging Versus Positron Emission Tomography/Computed Tomography for Early Response Assessment of Liver Metastases to Y90-Radioembolization. *Invest Radiol*. 2015;50:409–415.
13. Lecouvet FE, Chabot C, Taihi L, Kirchgessner T, Triqueneaux P, Malghem J. Present and future of whole – body MRI in metastatic disease and myeloma: how and why you will do it. *Skeletal Radiology*. 2024;53:1815–1831.
14. Marino MA, Avendano D, Zapata P, Riedl CC, Pinker K. Lymph Node Imaging in Patients with Primary Breast Cancer: Concurrent Diagnostic Tools. *The Oncologist*. 2020;25:231-242.
15. Morawitz J, Bruckmann NM, Dietzel F, Ullrich T, Bittner AK, Hoffmann O, et al. Comparison of nodal staging between CT, MRI, and 18F – FDG PET/MRI in patients with newly diagnosed breast cancer. *European Journal of Nuclear Medicine and Molecular Imaging*. 2021;49:992-1001.

-
16. Aktas A, Gurleyik MG, Aksu SA, Aker F, Gugor S. Diagnostic Value of Axillary Ultrasound, MRI, and 18F – FDG – PET/CT in Determining Axillary Lymph Node Status in Breast Cancer Patients. *Eur J Breast Health*. 2022;18(1):37-47.
 17. Fares J, Kanojia D, Rashidi A, Ahmed AU, Balyasnikova IV, Lesniak MS. Diagnostic Clinical Trials in Breast Cancer Brain Metastases: Barriers and innovations. *Clin Breast Cancer*. 2019;19(6):383–391.
 18. Mohan P, Antonelou M, Dadzie O, Dubrey S. Headache in a young woman: leptomeningeal metastasis as the first presentation of underlying breast malignancy. *BMJ Case Rep*. 2015;2015:bcr2014207643.
 19. Short RG, Bal S, German JP, Poelstra RJ, Kardan A. Potential of F-18 PET/CT in the Detection of Leptomeningeal Metastasis. *The Neuroradiology Journal*. 2014;27:685-689.
 20. Shan S, Rangarajan V, Purandare N, Luthra K, Medhi S. 18F – FDG uptakes in leptomeningeal metastases from carcinoma of the breast on a positron emission tomography/computerized tomography study. *The Indian Journal of Cancer*. 2007;44(3):115-118.
 21. Constantinidou A, Martin A, Sharma B, Johnston SRD. Positron emission tomography/computed tomography in the management of recurrent/metastatic breast cancer: a large retrospective study from the Royal Marsden Hospital. *Annals of Oncology*. 2011;22:307-314.

ULOGA MR, CT I PET/CT DIJAGNOSTIČKIH SLIKOVNIH PRETRAGA U PRAĆENJU BOLESNIKA SA METASTATSKIM KARCINOMOM DOJKE

Toni Džeba 

Fakultet zdravstvenih studija, Sveučilište u Mostaru, Mostar, Bosna i Hercegovina

SAŽETAK

Uvod: Karcinom dojke spada među najčešće dijagnosticirane maligne bolesti, a njegova incidencija u posljednjih nekoliko desetljeća kontinuirano raste. Predstavlja vodeći uzrok smrtnosti od karcinoma u ženskoj populaciji. Unatoč napretku u dijagnostici i liječenju, recidiv bolesti i metastatski oblik i dalje predstavljaju značajan klinički izazov.

Materijali i metode: Provedena je pretraga znanstvene literature u bazi PubMed korištenjem ključnih riječi: radiology imaging, metastatic breast cancer, PET/CT, MRI i MSCT. Od ukupno 88 identificiranih radova, 21 je odabran za detaljnu analizu prema kriterijima relevantnosti, kvalitete i dostupnosti.

Rezultati: Analiza je pokazala da su MRI i PET/CT modaliteti najosjetljiviji i najspecifičniji u detekciji metastaza kod raka dojke, osobito u kostima, jetri i mozgu. MRI omogućuje rano otkrivanje metastatskih promjena zahvaljujući visokoj prostornoj rezoluciji, dok PET/CT pruža dodatne metaboličke informacije koje nadopunjuju anatomske prikaze. CT je standardno dostupan modalitet, ali s nižom osjetljivošću u ranom otkrivanju metastaza.

Zaključak: Kombinacija različitih slikovnih metoda (MRI + PET/CT) pruža komplementarne informacije i povećava točnost dijagnostike. Odabir optimalnog modaliteta treba individualizirati prema tipu karcinoma, kliničkoj slici i dostupnosti tehnologije.

Ključne riječi: dojka, metastaze, MR, CT, PET/CT.

Osoba za korespondenciju: Toni Džeba, mag. rad. teh.; toni.dzeba@gmail.com

ARTIFICIAL INTELLIGENCE IN THE ROLE OF STROKE DETECTION IN HERZEGOVINA-NERETVA CANTON

Marin Brajković^{ID}, Gojko Bogdan^{ID}, Marko Krpan^{ID}, Bruno Rajič^{ID}

University Clinical Hospital Mostar, 88 000 Mostar, Bosnia and Herzegovina

Received on 16.5.2025.

Reviewed on 29.10.2025.

Accepted on 12.11.2025.



ABSTRACT

Stroke is the leading cause of disability in both Bosnia and Herzegovina and Western countries and ranks as the second most common cause of death globally. Strokes are classified into two major categories: ischemic and hemorrhagic. Ischemic strokes account for approximately 85% of all cases, resulting from vascular occlusion, while 10% are due to primary intracerebral hemorrhage and 5% due to subarachnoid hemorrhage. Early intervention in acute stroke cases can lead to full recovery or significantly reduce long-term consequences. Therefore, early symptom recognition, rapid diagnostics, and timely access to treatment options are essential. In addition to thrombolysis, which has been performed for many years, mechanical thrombectomy has been available at the University Clinical Hospital Mostar since late 2022. To ensure patients receive appropriate therapy, thrombolysis and/or mechanical thrombectomy as quickly as possible, stroke symptoms must be promptly identified and diagnostic procedures initiated. Since 2023 Herzegovina-Neretva Canton has implemented an automated platform for rapid stroke detection called Canon AUTOSroke. This AI-based system automatically detects strokes and immediately alerts the designated stroke intervention team via established communication channels. Canon AUTOSroke utilizes deep learning, a form of artificial intelligence that enables computers to process data in a manner inspired by the human brain. By using this AI application, the time required to make therapeutic decisions is significantly reduced, which can be critical to the outcome of acute stroke treatment.

Keywords: artificial intelligence, stroke, early detection, diagnostics, intervention

Corresponding author: Marin Brajković, mag. rad. tehn.; marin.brajkovic@fzs3.sum.ba

INTRODUCTION

Stroke is the leading cause of disability in Bosnia and Herzegovina and Western countries, and the second leading cause of death worldwide. Strokes are divided into two major types: ischemic and hemorrhagic. Ischemic strokes are far more prevalent, accounting for 85% of all cases, caused by vascular occlusion, while 10% are due to primary intracerebral hemorrhage and 5% are due to subarachnoid hemorrhage (1). Stroke results in reduced or absent oxygen supply to the brain, leading to neuronal death. The phrase “time is brain,” commonly used in stroke care, underscores the critical importance of early detection and urgent intervention (2). Timely treatment of acute stroke can result in full recovery or significantly lessen long-term effects (3). In recent years, research has been increasingly focused on the application of artificial intelligence (AI) in stroke detection. A 2020 review by Vivek S. Yedavalli, published in *Neuroimaging Clinics of North America*, highlights AI’s role in image analysis, diagnostic optimization and outcome prediction (4). Similar studies confirm that AI algorithms, particularly deep learning, can automatically detect signs of hemorrhagic and ischemic stroke on CT scans, often with accuracy comparable to radiology specialists (5,6). The aim of this review is to present the potential of AI in stroke detection and to analyze the impact of automated diagnostic platforms on timely therapeutic decision-making.

Diagnostics and Intervention in the Herzegovina-Neretva Canton

In addition to pharmacological clot dissolution via thrombolysis, which has

been performed for many years, mechanical thrombectomy (MT) has been available at the University Clinical Hospital Mostar since late 2022. For patients to receive timely therapy - thrombolysis and/or MT - stroke symptoms must be promptly recognized and appropriate diagnostics performed. The Radiology Department in Mostar successfully diagnoses all types of strokes. Emergency patients undergo brain MSCT scans and, when necessary, MSCT angiography of vertebral and cerebral arteries, as well as MSCT brain perfusion (7). Since 2023, the Canon AUTOSTroke platform has been available in HNC for rapid and simplified stroke detection. It is currently used by three institutions: University Clinical Hospital Mostar, Safet Mujić Hospital and Konjic General Hospital. However, University Clinical Hospital Mostar serves as the only comprehensive center in the canton, since it provides both diagnostics and emergency stroke interventions.

Canon AUTOSTroke

Canon AUTOSTroke is an automated diagnostic platform for stroke patients (8). Based on artificial intelligence, it autonomously detects strokes and immediately alerts the designated intervention team via established communication channels. The existing PACS (Picture Archiving and Communication System) network in HNC is fully compatible with Canon AUTOSTroke, facilitating the implementation of its advanced capabilities. The platform consists of four distinct applications, each responsible for detecting specific acute stroke conditions based on stroke type or cause. Canon

AUTOSroke employs deep learning, a form of AI that enables computers to learn and process data in a brain-inspired manner (9). The system includes several modules: ICH AUTOSroke detects signs of intracranial hemorrhage on non-contrast CT scans, studied on over 10,000 cases (10); ASPECTS algorithms assist in identifying ischemic regions and thereby enable assessing stroke severity, which is crucial for therapy selection (11); Large Vessel Occlusion module accurately detects major vessel blockages via CT angiography; and CT Brain Perfusion provides functional brain tissue assessment with perfusion maps and visualizations of potential infarct core and penumbra regions (12,13). All applications share a common goal: to rapidly process patient data and promptly alert medical teams for emergency stroke intervention.

THE ROLE OF A MEDICAL RADIOLOGY ENGINEER

At the Clinical Department of Radiology at the University Clinical Hospital Mostar, the GE Revolution MSCT scanner is used as one of the most advanced devices for high quality imaging in radiological diagnostics. This system supports sophisticated protocols for neurological examinations, including angiographic procedures and brain MSCT perfusion, which are essential for early stroke detection (14). A pivotal and irreplaceable role in this diagnostic chain is held by the medical radiology engineer, who is responsible for conducting complex scans using the MSCT device. To fully utilize the capabilities of the Canon AUTOSroke platform, high-quality imaging data must be acquired, which the application then processes. In addition to performing the

scan correctly, the engineer must complete it in the shortest possible time.

DIAGNOSTIC WORKFLOW AND PATIENT MANAGEMENT

Upon receiving notification that a patient with suspected stroke is arriving, the medical radiology engineer ensures the scanner is warmed up and prepares the automatic injector for contrast administration. After positioning the patient, the next step is defining the field of view (FOV) on the CT device. Standard protocols for suspected ischemic stroke include a non-contrast brain CT and CT angiography of the brain, which enables visualization of intracranial arteries and assessment of occlusions. Frequently, CT angiography of the aortic arch and supra-aortic vessels is also performed to evaluate stenosis and occlusions in major arteries (15). If needed, brain CT perfusion is conducted to analyze cerebral blood flow and identify ischemic core and penumbra regions (16). These methods allow for rapid and accurate vascular assessment and perfusion parameter evaluation in patients with suspected acute stroke.

During the scan, the engineer monitors patient's condition, checking for adverse reactions to contrast, as well as the volume, flow rate and pressure of the contrast agent. In cases of extravasation due to vein rupture, the engineer must immediately halt the scan. Therefore, verifying the intravenous access prior to imaging is critical. All procedures must comply with imaging protocols and the patient's clinical status (17). After the scan, the engineer assists medical staff in transferring the patient to a mobile stretcher and verifies that raw data have been successfully transmitted to the hospital information

system and image archiving platform. The data are then processed by Canon AUTOSTroke application, which uses AI to automatically interpret the images and generate a report highlighting stroke-related abnormalities. Through mobile technologies, the system alerts the radiology and neurology teams in real time (18).

The resulting data assist interventional radiologists and neurologists in making therapeutic decisions, including timely interventions such as mechanical thrombectomy (19). By using AI applications, the time required for therapeutic decision-making is significantly reduced, which can be critical to patient outcomes in acute stroke cases (20). Information such as stroke onset time and recovery potential are essential for selecting appropriate treatment strategies (21). At University Clinical Hospital Mostar, notable improvements have been observed following the implementation of advanced AI tools, which include reduced “door-to-diagnosis” time, increased eligibility for mechanical thrombectomy and automatic generation of reports with marked pathologies for the neurointervention team. However, it is important to emphasize that these tools do not replace expert radiological assessment, but rather serve as a supportive system that enhances clinical workflow and treatment efficacy within the critical therapeutic window. (22).

CONCLUSION

The application of artificial intelligence in stroke diagnostics and management represents a major advancement in modern medicine, particularly in emergency settings where time is a decisive factor.

The introduction of the Canon AUTOSTroke platform in healthcare institutions across Herzegovina-Neretva Canton has enabled faster stroke recognition, automated image analysis and timely alerting of specialized teams. The integration of advanced tools with existing diagnostic procedures - alongside the essential role of the medical radiology engineer - has resulted in reduced time from patient arrival to therapeutic decision. Although the platform does not replace the radiologist’s expert interpretation, it is a valuable asset that optimizes clinical workflow and contributes to improved healthcare quality and patient outcomes.

LITERATURE

1. Dunbabin DW, Sandercock PA. Investigation of acute stroke: what is the most effective strategy? *Postgrad Med J*. 1991;67(785):259–70.
2. Gomez CR. Time is brain: the stroke theory of relativity. *J Stroke Cerebrovasc Dis*. 2018;27(8):2214–27.
3. Colton K, et al. Early stroke recognition and time-based emergency care performance metrics for intracerebral hemorrhage. *J Stroke Cerebrovasc Dis*. 2020;29(2):104552.
4. Yedavalli VS. Artificial intelligence in stroke imaging: Current and future perspectives. *Neuroimaging Clin N Am*. 2020;30(4):539–49.
5. Zaharchuk G, Gong E, Wintermark M, Rubin D, Langlotz C. Artificial Intelligence in Stroke Imaging: Current Status and Future Perspectives. *J Neuroradiol*. 2020;47(1):25–32.
6. Chilamkurthy S, Ghosh R, Tanamala S, Biviji M, Campeau NG, Venugopal VK, et al. Deep Learning Algorithms for Detection of Critical

- Findings in Head CT Scans: A Retrospective Study. *Lancet*. 2018;392(10162):2388–96.
7. Van den Wijngaard IR, et al. Value of whole brain computed tomography perfusion for predicting outcome after TIA or minor ischemic stroke. *J Stroke Cerebrovasc Dis*. 2015;24(9):2081–7.
8. Rava RA, et al. Assessment of an artificial intelligence algorithm for detection of intracranial hemorrhage. *World Neurosurg*. 2021;150:e209–17.
9. Matuliauskas D, Stražnickaitė I, Samuilis A, Jatužis D. Machine learning in acute stroke neuroimaging. A systematic literature review. *Neurol Semin*. 2023;26(2):41–9.
10. Schmitt N, Mokli Y, Weyland CS, et al. Automated detection and segmentation of intracranial hemorrhage suspect hyperdensities in non-contrast-enhanced CT scans of acute stroke patients. *Eur Radiol*. 2022;32(4):2246–54.
11. Fan Y, Song Z, Zhang M. Emerging frontiers of artificial intelligence and machine learning in ischemic stroke: a comprehensive investigation of state-of-the-art methodologies, clinical applications, and unraveling challenges. *EPMA J*. 2023;14(4):645–61.
12. Rava RA, Peterson BA, Seymour SE, et al. Validation of an artificial intelligence-driven large vessel occlusion detection algorithm for acute ischemic stroke patients. *Neuroradiol J*. 2021;34(5):408–17.
13. Václavík D, Volný O, Cimřlová P, Švub K, Dvorníková K, Bar M. The importance of CT perfusion for diagnosis and treatment of ischemic stroke in anterior circulation. *J Integr Neurosci*. 2022;21(3):92.
14. Cheng HW, et al. The application value of gemstone spectral imaging (GSI) combined with an 80 mm wide-body detector in head-neck CTA. *Curr Med Imaging*. 2024;20(1)
15. Patil S, et al. Detection, diagnosis and treatment of acute ischemic stroke: current and future perspectives. *Front Med Technol*. 2022;4:748949. doi:10.3389/fmedt.2022.748949
16. de Vries L, et al. PerfU-Net: Baseline infarct estimation from CT perfusion source data for acute ischemic stroke. *Med Image Anal*. 2023;85:102749.
17. Abu Awwad D, et al. Radiography students' knowledge, attitude and practice relating to infection prevention and control in the use of contrast media injectors in computed tomography. *J Med Radiat Sci*. 2024
18. Bat-Erdene B-O, Saver JL. Automatic acute stroke symptom detection and emergency medical systems alerting by mobile health technologies: A review. *J Stroke Cerebrovasc Dis*. 2021;30(7):105826.
19. Almallouhi E, et al. Outcomes of mechanical thrombectomy for patients with stroke presenting with low Alberta stroke program early computed tomography score in the early and extended window. *JAMA Netw Open*. 2021;4(12):e2137708.
20. Soun JE, et al. Artificial intelligence and acute stroke imaging. *AJNR Am J Neuroradiol*. 2021;42(1):2–11.
21. Marcus A, et al. Deep learning biomarker of chronometric and biological ischemic stroke lesion age from unenhanced CT. *NPJ Digit Med*. 2024;7(1):1–10.

22. Waymel Q, et al. Impact of the rise of artificial intelligence in radiology: what do radiologists think? Diagn Interv Imaging. 2019;100(6):327–36.

UMJETNA INTELIGENCIJA U ULOZI DETEKCIJE MOŽDANIH UDARA U HERCEGOVAČKO-NERETVANSKOJ ŽUPANIJ

Marin Brajković^{ID}, Gojko Bogdan^{ID}, Marko Krpan^{ID}, Bruno Rajič^{ID}
Sveučilišna klinička bolnica Mostar, 88 000 Mostar, Bosna i Hercegovina

SAŽETAK

Moždani udar je vodeći uzrok invaliditeta kako u BiH tako i u zapadnim zemljama, također nalazi se na drugom mjestu kao glavni uzrok smrtnosti u svijetu. Dijelimo ih na dvije veće skupine, ishemijski i hemoragijski moždani udar. Ishemijski su znatno zastupljeniji odnosno 85% svih udara, nastaju zbog začepljenja krvnih žila dok preostalih 10 % otpada na primarnu intracerebralnu hemoragiju te 5% na subarahnoidalno krvarenje. Rana intervencija kod akutnog moždanog udara može dovesti do potpunog oporavka pacijenta ili znatnog smanjenja posljedica. Iz tog razloga veoma je bitno rano prepoznavanje simptoma zatim što brža dijagnostika i naposljetku dostupni načini liječenja. Pored trombolize koja se obavlja već duži niz godina, u Sveučilišnoj kliničkoj bolnici Mostar je od kraja 2022. godine dostupna i metoda Mehaničke trombektomije. Da bi pacijent što prije dobio adekvatnu terapiju odnosno trombolizu i/ili mehaničku trombektomiju potrebno je prepoznati simptome koji upućuju na moždani udar te napraviti potrebnu dijagnostiku. Od 2023. godine na području Hercegovačko - Neretvanske županije je dostupna automatizirana platforma za brzo i lakše prepoznavanje moždanih udara pod nazivom Canon AUTOSTroke. Ova platforma je zasnovana na umjetnoj inteligenciji i potpuno automatski detektira moždane udare. Putem već uspostavljene komunikacije u trenutku alarmira kontakt osobe uključene u tim za intervencije kod hitnih moždanih udara. Canon AUTOSTroke koristi metodu „deep learning“, što je metoda dubokog učenja umjetne inteligencije koja računala uči da obrađuju podatke na način inspiriran ljudskim mozgom. Korištenjem UI aplikacije, vrijeme do donošenja terapijskih odluka značajno se skraćuje, što može imati presudnu ulogu u ishodu liječenja pacijenata s akutnim moždanim udarom.

Ključne riječi: umjetna inteligencija, moždani udar, rana detekcija, dijagnostika, intervencija

Autor za korespondenciju: Marin Brajković, mag. rad. tehn.; marin.brajkovic@fzs3.sum.ba

THE IMPACT OF PHYSICAL ACTIVITY ON QUALITY OF LIFE AND MENTAL HEALTH

Andrea Božurić¹  & Mateja Briševac² 

¹University of Applied Health Sciences Zagreb, 10 000 Zagreb, Croatia

²Catholic University of Croatia, 10 000 Zagreb, Croatia

Received on 4.6.2025.

Reviewed on 13.6.2025.

Accepted on 10.10.2025.



ABSTRACT

In modern society, physical activity is essential for preventing physical illnesses and improving mental health and overall quality of life. This paper explores the effects of physical activity on psychophysical health across different life stages and highlights the role of physiotherapy in promoting active lifestyles. Physical activity serves as a therapeutic tool for mental disorders, including anxiety, depression, stress, psychotic disorders, and dementia. It also boosts self-confidence, enhances cognitive function, and encourages socialization, making it a cornerstone of holistic well-being.

The COVID-19 pandemic emphasized the importance of physical activity for mental health. During lockdowns, reduced activity led to increased anxiety and depression symptoms. Studies show that individuals who maintained regular physical activity experienced fewer mental health issues compared to those who were less active. These findings confirm its role in mitigating the psychological effects of isolation and uncertainty, particularly during challenging times.

According to the WHO, at least 30 minutes of moderate activity daily or 150 minutes weekly is recommended. Regular physical activity reduces the risk of cardiovascular diseases, diabetes, osteoporosis, obesity, and mental disorders, while also slowing the progression of existing conditions. Starting physical activity early in life fosters lifelong healthy habits, ensuring long-term benefits for both physical and mental health.

Physiotherapists play a vital role in promoting physical activity, tailoring programs to individuals based on age, health status, and limitations. The availability of diverse activity options, from yoga to strength training, ensures everyone can find suitable choices. By integrating physical activity into daily routines, individuals can achieve better health outcomes and improved quality of life.

Keywords: physical activity, mental health, depression, COVID-19, physiotherapy

Corresponding author: Andrea Božurić, Master of Physiotherapy; bozuric18@gmail.com

INTRODUCTION

During physical activity, physical and mental cycles are closely interconnected, with thoughts, feelings, and mood depending on biochemical processes in the body. When these mechanisms are out of balance, psychological disorders arise, reflected in changes in an individual's experiences, behavior, and physical symptoms. Today, the importance of addressing mental health through physical activity is emphasized, as exercise not only improves aerobic capacity and muscle strength but also enhances overall well-being. People who exercise regularly feel more energetic, sleep better, have improved memory, and a more positive outlook. Exercise also reduces symptoms of depression, anxiety, and ADHD, even in small amounts, regardless of age or fitness level (1). Despite evidence of the benefits of exercise, most people do not engage in it. Globally, 31% of the population is insufficiently active, while in Croatia, this percentage reaches 60%. Women and older adults are less active than men and younger individuals. A sedentary lifestyle is the fourth leading cause of death, according to the WHO, after high blood pressure, smoking, and high blood sugar (2).

The objectives of this paper are: (1) to list and describe the effects of physical activity on physical and mental health and quality of life; (2) to present and describe the mechanisms of physical activity on mental health in different age groups; (3) to describe the role of physiotherapy and physiotherapists in promoting physical activity and preserving mental health; and (4) to present the prevalence of physical activity during the COVID-19 pandemic and its consequences on physical and mental health. This paper aims to provide a comprehensive overview of current

knowledge on the relationship between physical activity and psychophysical health, with an emphasis on practical implications for promoting an active lifestyle.

METHODS AND PARTICIPANTS

This review paper is based on the analysis of existing research studies and relevant literature, focusing on the impact of physical activity on mental health and general psychological well-being. Mental health, which encompasses emotional, psychological, and social well-being, is crucial for all stages of life, from childhood to adulthood. According to estimates from the National Institute of Mental Health (NIMH), in 2017, approximately 11.2 million adults in the U.S., or about 4.5% of adults, had serious psychological disorders (3).

The methods used included the analysis of existing epidemiological data, interviews with participants, and longitudinal studies that tracked the impact of physical activity on psychological state over a period of at least six months. Physical exercise is increasingly used as a means to maintain and strengthen mental health, with research showing that aerobic activities of 20 to 40 minutes can cause transient improvements in mood and reduced anxiety, with these effects being most pronounced in individuals with elevated levels of anxiety (4).

Additionally, evidence from clinical studies shows that the psychological benefits of exercise are comparable to the effects of standard forms of psychotherapy. In healthy individuals, exercise can have a preventive effect, while in individuals with mild to moderate emotional disorders, it can act as a therapeutic tool (5). However, excessive reliance on exercise can cause

mood disorders and worsen physical health.

Statistical data show that the prevalence of psychological problems varies worldwide. In some countries, about 10-20% of children and adolescents show signs of psychological problems, while 7% require psychological treatment (6). In the United Kingdom, approximately one in four people will experience at least one diagnosed mental health disorder during their lifetime

(7). Various theories explain the psychological benefits of physical activity. Physiological theories, such as neurotransmitter theories involving serotonin, dopamine, and endorphins, link physical activity to improved mood (8). Endorphins, known as "happiness hormones," are released during exercise and contribute to feelings of euphoria, reducing symptoms of depression and anxiety (9).

Psychological hypotheses further explain the mechanisms behind the positive effects of exercise. The distraction hypothesis suggests that exercise helps people eliminate negative thoughts and gain a brighter outlook on life's challenges (10).

The mastery hypothesis assumes that physical activity increases self-confidence and a sense of achievement, while the social interaction hypothesis emphasizes the effect of socializing during exercise on positive mood (11).

Further analyses have shown that physical activity can improve the mood of individuals suffering from depression. For example, an aerobics program conducted over several weeks resulted in a significant reduction in depressive symptoms (12). Additionally, oxygen-based exercises, such as swimming, brisk walking, and cycling, are recommended three to four times a

week for at least 45 minutes to achieve optimal results (13).

The impact of physical activity on self-esteem has also been documented. Self-esteem, which represents a subjective assessment of one's own worth, is a key aspect of mental health (14). Individuals with higher self-esteem show more positive attitudes toward themselves, while those with lower self-esteem may develop feelings of inferiority and discouragement. Research has shown that physical activity can improve self-esteem, increase self-confidence, and reduce symptoms of mild depression and anxiety (15).

RESULTS

The analysis of existing studies confirms that physical activity has a positive impact on mental health in different populations. In children and adolescents, regular physical activity is associated with a 30-40% reduction in symptoms of anxiety and depression, which is particularly important given the rise in mental disorders in this age group (30). Physical activity helps develop social skills, reduces stress related to school obligations, and improves self-esteem (31). In adults, studies have shown that weekly aerobic activity of 150 minutes can reduce the risk of developing depression by 26% (32).

Group sports activities have proven to be particularly effective in improving mental health. For example, participation in team sports is associated with a 20% greater improvement in the sense of belonging and a reduction in feelings of loneliness compared to individual activities (33). Team sports provide opportunities for social interaction, support, and a sense of community, which is especially important for individuals struggling with feelings of isolation (34). These data highlight the

importance of the social component in physical activity programs.

The long-term effects of physical activity on mental health have also been demonstrated. Longitudinal studies that followed participants for 5 years showed that individuals who exercise regularly have a 40% lower risk of developing clinical depression compared to inactive individuals (35). These results confirm that physical activity is not only a short-term solution but also a long-term strategy for maintaining mental health. Regular activity can also reduce the risk of cognitive decline and dementia in older age (36).

DISCUSSION

The results of this review confirm the significant impact of physical activity on mental health, consistent with numerous studies that have addressed this topic. According to data from the World Health Organization (WHO), regular physical activity can reduce the risk of depression by 20-30%, while in individuals who already have symptoms of depression, improvement can be achieved in 45-50% of cases (16, 17). These data confirm that physical activity is not only a preventive measure but also an important therapeutic tool in the treatment of mental disorders.

Physiological mechanisms, such as increased production of endorphins, serotonin, and dopamine, are key in explaining the positive effects of exercise on psychological state (18). Endorphins, known as "happiness hormones," reduce the feeling of pain and increase the sense of satisfaction, while serotonin and dopamine play a key role in regulating mood and motivation

(19). Research has shown that even short-term moderate activity, such as 30 minutes of brisk walking three times a week, can

significantly reduce symptoms of anxiety and depression (20). In addition, regular physical activity improves sleep quality, which is also an important factor in maintaining mental health (21).

Psychological aspects, such as increased self-confidence and a sense of achievement, also play an important role in improving mental health (22, 23). Physical activity helps build self-esteem through achieving goals, whether it is weight loss, improved fitness, or mastering new skills. Additionally, group activities, such as team sports or group training, provide opportunities for social interaction, which can reduce feelings of loneliness and increase a sense of belonging (24).

However, it is important to note that excessive physical activity can have negative consequences. Exercise addiction, which occurs in approximately 10% of individuals who engage in intense sports, can lead to worsening mental health and an increased risk of injury

(25). Exercise addiction is often associated with eating disorders, anxiety, and depression, highlighting the need for a balanced approach to physical activity (26). Therefore, it is crucial to adapt the intensity and type of activity to individual needs and capabilities, with professional guidance if necessary.

Studies in recent years further emphasize the importance of tailored physical activity programs for different age groups. For example, a 2022 study showed that yoga and mindfulness-based programs are particularly effective in reducing stress and anxiety in older adults, with improvement in 65% of cases (27). Yoga, which combines physical movements, breathing exercises, and meditation, helps reduce cortisol, the stress hormone, and improves overall psychological well-being (28).

These results highlight that personalized approaches can be key to achieving optimal results.

Additionally, the combination of physical activity with other interventions, such as cognitive-behavioral therapy (CBT), has proven to be highly effective. A 2021 meta-analysis showed that such a combination reduces symptoms of depression by 60% compared to therapy alone (29). CBT helps patients recognize and change negative thought patterns, while physical activity contributes to the release of neurotransmitters that improve mood. These findings confirm the importance of an integrated approach to treating mental disorders.

CONCLUSION

There is increasing evidence that physical activity has a profound and positive impact on mental health, particularly in reducing symptoms of anxiety, stress, and depression. Through physiological mechanisms, such as increased production of endorphins, serotonin, and dopamine, and reduced inflammatory processes, exercise not only improves mood but also contributes to overall health. These biochemical processes, along with psychological effects such as increased self-confidence and a sense of achievement, make physical activity a powerful tool in combating mental disorders. It is particularly important to highlight the role of physical activity in adolescence, a period when a decline in physical activity often occurs, which can lead to an increased risk of mental problems. The World Health Organization (WHO) recommendations of one hour of moderate to vigorous activity daily for adolescents are crucial for promoting mental and physical well-being. Research

also shows that regular physical activity can offset a genetic predisposition to depression, which is particularly important for adults at high risk. Physical activity is not only a preventive measure but also an important therapeutic tool. Aerobic exercises and resistance training have been shown to be effective in improving cognitive function in older adults, reducing symptoms of depression and anxiety, and increasing quality of life. Additionally, group activities, such as team sports or dance therapy, provide additional benefits through social interaction and a sense of belonging, which is especially important for individuals struggling with feelings of loneliness. Physiotherapists play a key role in promoting physical activity and mental well-being. As experts in movement and mobility, they can help individuals find appropriate forms of activity tailored to their needs and capabilities. In the era of modern lifestyles, which often involve prolonged sitting and reduced physical activity, the role of physiotherapists becomes increasingly important in the prevention and treatment of both physical and mental disorders. In conclusion, physical activity represents a simple yet highly effective way to improve mental health and quality of life. Its effects range from reducing symptoms of depression and anxiety to improving cognitive function and social connectedness. Integrating physical activity into daily life, with the support of professionals, can be key to achieving long-term mental and physical well-being.

REFERENCES

1. Berger BG, Motl RW. Exercise and mood: A selective review and synthesis of research employing the profile of mood

- states. *J Appl Sport Psychol*. 2002;12(1):69-92.
2. Jurakić D, Heimer S. Prevalencija nedovoljne tjelesne aktivnosti u Hrvatskoj i svijetu: pregled istraživanja. *Arh Hig Rada Toksikol*. 2012;63(3):3-13.
3. Stephens T. Physical activity and mental health in the United States and Canada: Evidence from four population surveys. *Prev Med*. 1988;17:35-47.
4. Žigman A., Ružić L. Utjecaj tjelesne aktivnosti na raspoloženje--fiziološki mehanizmi. *Hrvatski športskomedicinski vjesnik*. 2008;23(2):75-82.
5. Rocheleau CA, Webster GD, Bryan A., Frazier J. Moderators of the relationship between exercise and mood changes: Gender, exertion level, and workout duration. *Psychol Health*. 2004;19(4):491-506.
6. Cox RH. *Sport psychology: Concepts and applications*. 7th ed. New York: McGraw- Hill; 2012.
7. Shaw D., Gorely T., Corban R. *Instant notes in sport and exercise psychology*. Garland Science/Bios Scientific Publishers; 2005.
8. Berk LA. *Exploring Lifespan Development*. 2nd ed. Prentice Hall; 2010.
9. North TC, McCullagh P., Tran ZV. Effect of exercise on depression. *Exerc Sport Sci Rev*. 1990;18(1):379-416.
10. Penedo FJ., Dahn JR. Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Curr Opin Psychiatry*. 2005;18(2):189-193.
11. Wang Y., Monteiro C., Popkin BM. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China and Russia. *Am J Clin Nutr*. 2002;75:971-7.
12. Mišigoj-Duraković M. i suradnici. *Tjelesno vježbanje i zdravlje*. 1999.
13. Weinberg RS, Gould D. *Foundations of sport and exercise psychology*. 5th ed. Champaign, IL: Human Kinetics; 2011.
14. World Health Organization. *Physical activity and adults*. Geneva: WHO; 2020.
15. Schuch FB, Vancampfort D, Firth J, et al. Physical activity and incident depression: a meta-analysis of prospective cohort studies. *Am J Psychiatry*. 2018;175(7):631-648.
16. Mikkelsen K, Stojanovska L, Polenakovic M, et al. Exercise and mental health. *Maturitas*. 2017;106:48-56.
17. Craft LL, Perna FM. The benefits of exercise for the clinically depressed. *Prim Care Companion J Clin Psychiatry*. 2004;6(3):104-111.
18. Fox KR. The influence of physical activity on mental well-being. *Public Health Nutr*. 1999;2(3a):411-418.
19. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med*. 2011;45(11):886-895.
20. Freimuth M, Moniz S, Kim SR. Clarifying exercise addiction: differential diagnosis, co-occurring disorders, and phases of addiction. *Int J Environ Res Public Health*. 2011;8(10):4069-4081.
21. Smith PJ, Merwin RM. The role of exercise in management of mental health disorders: an integrative review. *Annu Rev Med*. 2021;72:45-62.
22. Kvam S, Kleppe CL, Nordhus IH, et al. Exercise as a treatment for depression: A meta- analysis. *J Affect Disord*. 2016;202:67-86.
23. Rodriguez-Ayllon M, Cadenas-Sánchez C, Estévez-López F, et al. Role of physical activity and sedentary behavior in

the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. *Sports Med.* 2019;49(9):1383-1410.

24. Mammen G, Faulkner G. Physical activity and the prevention of depression: a systematic review of prospective studies. *Am J Prev Med.* 2013;45(5):649-657.

25. Eime RM, Young JA, Harvey JT, et al. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act.* 2013;10:98.

26. Schuch FB, Stubbs B. The role of exercise in preventing and treating depression. *Curr Sports Med Rep.* 2019;18(8):299-304.

27. Koch SC, Riege RFF, Tisborn K, et al. Effects of dance movement therapy and dance on health-related psychological outcomes. A meta-analysis update. *Front Psychol.* 2023;14:1186407.

28. Biddle SJH, Ciaccioni S, Thomas G, et al. Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. *Psychol Sport Exerc.* 2019;42:146-155.

29. Lubans D, Richards J, Hillman C, et al. Physical activity for cognitive and mental health in youth: A systematic review of mechanisms. *Pediatrics.* 2016;138(3):e20161642.

30. Harvey SB, Øverland S, Hatch SL, et al. Exercise and the prevention of

depression: Results of the HUNT cohort study. *Am J Psychiatry.* 2018;175(1):28-36.

31. Vella SA, Swann C, Batterham M, et al. Ahead of the game protocol: A multi-component, community sport-based program targeting prevention, promotion and early intervention for mental health among adolescent males. *BMC Public Health.* 2018;18(1):390.

32. Eime RM, Young JA, Harvey JT, et al. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act.* 2013;10:98.

33. Schuch FB, Stubbs B. The role of exercise in preventing and treating depression. *Curr Sports Med Rep.* 2019;18(8):299-304.

34. Ahlskog JE, Geda YE, Graff-Radford NR, et al. Physical exercise as a preventive or disease-modifying treatment of dementia and brain aging. *Mayo Clin Proc.* 2011;86(9):876-884.

35. Koch SC, Riege RFF, Tisborn K, et al. Effects of dance movement therapy and dance on health-related psychological outcomes. A meta-analysis update. *Front Psychol.* 2023;14:1186407.

36. Strassel JK, Cherkin DC, Steuten L, et al. A systematic review of the evidence for the effectiveness of dance therapy. *Altern Ther Health Med.* 2011;17(3):50-59.

UTJECAJ TJELESNE AKTIVNOSTI NA KVALITETU ŽIVOTA I PSIHIČKO ZDRAVLJE

Andrea Božurić¹  & Mateja Briševac² 

¹Zdravstveno veleučilište Zagreb, 10 000 Zagreb, Hrvatska

²Hrvatsko katoličko sveučilište, 10 000 Zagreb, Hrvatska

SAŽETAK

U suvremenom društvu, tjelesna aktivnost postaje sve važnija ne samo za prevenciju fizičkih bolesti, već i za poboljšanje mentalnog zdravlja i ukupne kvalitete života. Cilj ovog rada bio je istražiti učinke tjelesne aktivnosti na psihofizičko zdravlje u različitim životnim dobima te istaknuti ulogu fizioterapije i fizioterapeuta u promicanju aktivnog načina života. Tjelesna aktivnost dokazano djeluje kao terapijsko sredstvo za brojne mentalne poremećaje, uključujući anksioznost, depresiju, stres, psihotične poremećaje i demenciju. Osim pozitivnog utjecaja na neurotransmitterske sustave, vježbanje povećava samopouzdanje, poboljšava kognitivne funkcije i potiče socijalizaciju.

Pandemija COVID-19 dodatno je istaknula važnost tjelesne aktivnosti za održavanje mentalnog zdravlja. Tijekom lockdowna, smanjenje fizičke aktivnosti dovelo je do porasta simptoma anksioznosti i depresije u općoj populaciji. Istraživanja pokazuju da su osobe koje su nastavile s redovitom tjelesnom aktivnošću tijekom pandemije imale manje mentalnih problema u usporedbi s onima koji su bili manje aktivni. Ovi nalazi potvrđuju da tjelesna aktivnost može biti ključna u smanjenju negativnih psiholoških učinaka izolacije i nesigurnosti.

Prema preporukama Svjetske zdravstvene organizacije (WHO), preporuča se najmanje 30 minuta umjerene aktivnosti dnevno ili 150 minuta tjedno. Redovita tjelesna aktivnost smanjuje rizik od kardiovaskularnih bolesti, dijabetesa, osteoporoze, pretilosti i mentalnih poremećaja, dok može usporiti napredovanje postojećih bolesti. Početak tjelesne aktivnosti u ranoj dobi ključan je za razvoj pozitivnih navika koje traju cijeli život.

Fizioterapeuti imaju ključnu ulogu u promicanju tjelesne aktivnosti, prilagođavajući programe pojedincima s obzirom na dob, zdravstveno stanje i ograničenja. U današnje vrijeme, dostupnost različitih oblika aktivnosti omogućuje svakome da pronađe onu koja najbolje odgovara njegovim potrebama i preferencijama.

Ključne riječi: tjelesna aktivnost, mentalno zdravlje, depresija, COVID-19, fizioterapija.

Autor za korespondenciju: Andrea Božurić, magistra fizioterapije; bozuric18@gmail.com

ADVANCEMENTS AND CLINICAL IMPLICATIONS OF OOCYTE IN VITRO MATURATION IN ASSISTED REPRODUCTIVE TECHNOLOGIES: A COMPREHENSIVE REVIEW OF PROTOCOLS, APPLICATIONS, AND FUTURE PERSPECTIVES

Asad Herić 

Department of Obstetrics and Gynaecology, University Clinical Hospital Mostar,
88 000 Mostar, Bosnia and Herzegovina

Received on 12.3.2025.

Reviewed on 13.5.2025.

Accepted on 8.7.2025.



ABSTRACT

In vitro maturation (IVM) has emerged as a promising alternative to conventional in vitro fertilization (IVF), particularly for patients with polycystic ovary syndrome (PCOS) and those requiring fertility preservation, such as cancer patients. Unlike traditional IVF, IVM does not rely on extensive ovarian stimulation, reducing the risk of ovarian hyperstimulation syndrome (OHSS) and offering a more patient-friendly approach with fewer injections and procedures. This narrative review evaluates recent advancements in IVM, focusing on various protocols, including standard, biphasic, and hCG-primed IVM, along with their respective advantages and challenges. Additionally, the review discusses clinical applications, ethical considerations, and economic aspects, highlighting IVM's potential for improving patient outcomes while minimizing treatment burdens. Despite ongoing challenges such as lower maturation rates and variable success in poor responders, IVM has shown promising results for specific patient populations, including those with oocyte maturation defects, resistant ovary syndrome (ROS), and those at risk for OHSS. While clinical uptake remains limited, future research aimed at improving protocols, enhancing oocyte recovery, and expanding indications for IVM could further integrate this technique into assisted reproductive technologies (ART), making it a vital tool for fertility preservation and ART optimization.

Keywords: In vitro maturation (IVM); Assisted reproductive technologies (ART); Oocyte maturation; Polycystic ovary syndrome (PCOS); Fertility preservation

Corresponding author: Asad Herić; asadheric@yahoo.com

INTRODUCTION

Assisted reproductive technologies (ARTs) were initially developed to address infertility and support family-building for sub-fertile individuals. Since the birth of Louise Brown in 1978, ARTs have evolved into a pivotal component of modern medicine, extending beyond infertility treatment to serve a broader population than originally envisioned. Among these advancements, oocyte in vitro maturation (IVM) has emerged as a promising alternative to conventional in vitro fertilization (IVF). The first successful IVF cycle was achieved in 1978 by Steptoe and Edwards (1), while the first successful IVM cycle was reported by Cha et al. in

1991 (2). Despite this later clinical adoption, the concept of IVM was first introduced by Edwards in 1965, demonstrating the ability to mature mammalian oocytes in vitro (3).

IVM is now precisely defined as the induction of meiotic maturation from prophase I to metaphase II in vitro, utilizing oocytes retrieved from small antral follicles (2–10 mm) in unstimulated or minimally stimulated ovaries (4). Unlike conventional IVF, which relies on ovarian hyperstimulation for oocyte retrieval from large antral follicles, IVM utilizes immature oocytes collected from unstimulated small antral follicles, as illustrated in Figure 1.

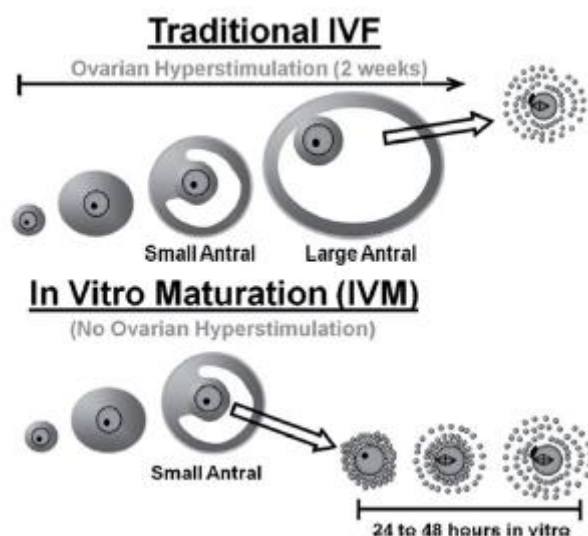


Figure 1. Oocyte Retrieval in IVM vs. Conventional IVF. (Adapted from 5)

IVM stands out from IVF due to its notable advantages, including reduced or absent gonadotropin stimulation, a lower risk of ovarian hyperstimulation syndrome (OHSS), and a more comfortable oocyte retrieval process (6, 7). The typical IVM cycle differs significantly from IVF, as it involves minimal administration of follicle-stimulating hormone (FSH) or

human menopausal gonadotropin (hMG) before oocyte retrieval and no ovulation trigger with human chorionic gonadotropin (hCG) (4). There are three major clinical IVM protocols: standard IVM, biphasic IVM, and hCG-primed IVM (8).

Standard IVM involves a one-step maturation process where germinal vesicle (GV)-stage cumulus–oocyte complexes

(COCs) develop to metaphase II (MII) in vitro, with or without prior FSH priming. Biphasic IVM introduces an additional pre-IVM culture phase, deliberately pausing meiosis for approximately 24 hours before exposure to meiosis-promoting conditions. Examples include the SPOM- and CAPA-IVM protocols, which require FSH priming but exclude hCG priming to maintain intact compact COCs. In hCG-primed IVM, patients receive an hCG bolus before oocyte retrieval, with or without prior FSH priming. This results in a subset (10–20%) of oocytes being MII at

retrieval, while others remain in various stages of meiosis, necessitating differential laboratory handling. Additionally, although it is not regarded as a clinical IVM procedure, post-IVF rescue IVM involves the maturation of GV-stage oocytes collected from stimulated IVF cycles after ovulation triggering, typically with hCG. These oocytes, often considered non-viable and discarded in conventional practice, are cultured in a denuded state from GV to MII. Different IVM protocols are illustrated in Figure 2.

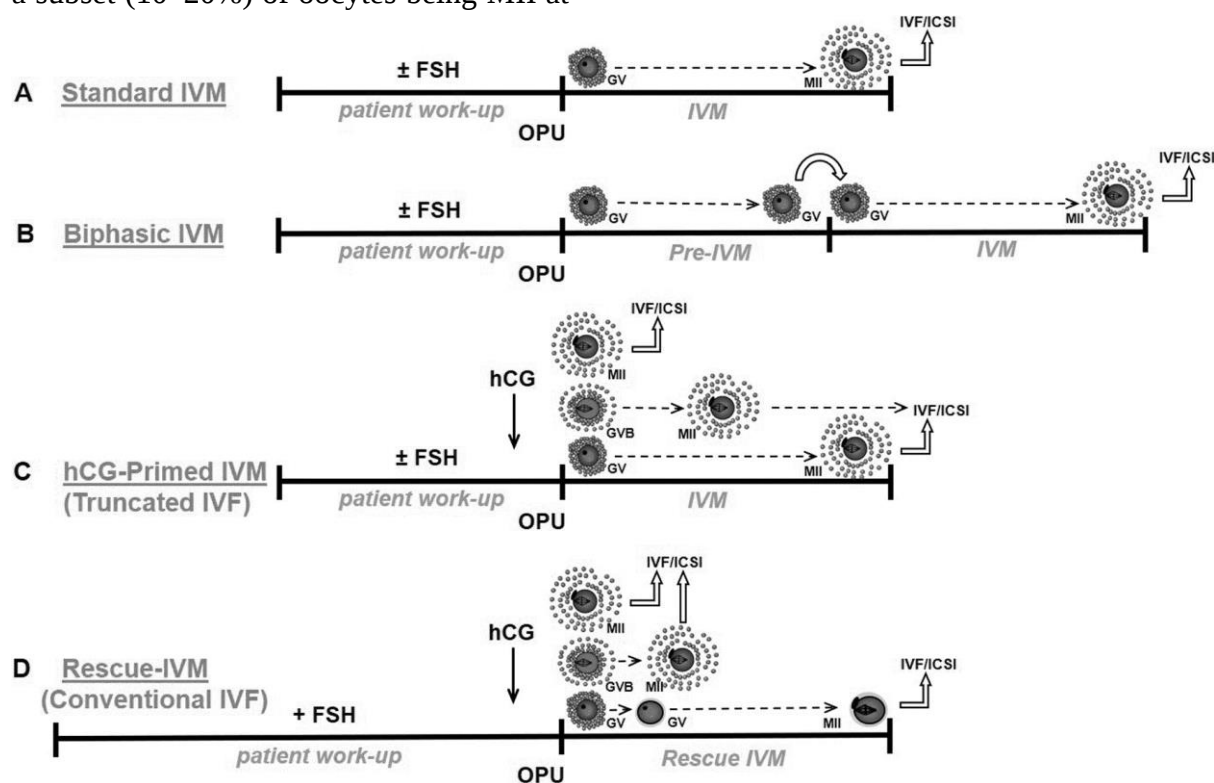


Figure 2. Major IVM protocols. Adopted from (9)

This review provides a comprehensive summary of the latest advancements, existing challenges, and future perspectives in oocyte in vitro maturation (IVM). Particular focus is given to technical aspects, clinical applications, ethical and economic considerations, and barriers to its widespread implementation in assisted

reproductive technologies (ART). By evaluating the current literature, this review aims to assess whether recent advancements in IVM demonstrate potential for optimizing outcomes. This article follows the Narrative Review reporting checklist.

METHODS

This manuscript is a qualitative narrative review conducted using PubMed as the primary database for literature searches. The search terms included: "oocyte in vitro maturation (IVM)," "oocyte maturation," and "IVM and PCOS." The review focused on studies published between 2014 and 2024, emphasizing advancements, clinical applications, ethical considerations, and economic aspects of IVM. Only studies

published in English were included. Priority was given to peer-reviewed articles, but relevant abstracts and case reports meeting the search criteria were also considered. Additionally, references cited within the reviewed studies were examined to broaden the scope of the analysis. Table 1 provides a detailed summary of the research strategy employed for this review.

Table 1. Summary of Research Strategy

Category	Details
Date of search	Searches performed between December 15, 2024 and January 1, 2025
Database	PubMed
Search Terms	"oocyte in vitro maturation (IVM)," "oocyte maturation," "IVM and PCOS"
Timeframe	Studies published between 2014 and 2024
Language	English-only studies were included
Inclusion Criteria	Peer-reviewed articles, abstracts, and case reports related to IVM
Exclusion Criteria	Non-English studies and publications unrelated to advancements, clinical applications, ethical or economic aspects of IVM
Focus Areas	Advancements in IVM, clinical applications, ethical considerations, economic aspects
Additional Sources	References cited in the reviewed studies were further explored

RESULTS

As with any emerging assisted reproductive technology, an anticipated barrier to clinical uptake of IVM will be access to clinical and laboratory knowhow of how to perform IVM. Consequently, many clinical practitioners are unclear about the current clinical status of IVM (9). A major gap for the field has been the need for a consensus statement on the clinical practice of IVM, something that in many respects has been addressed by the recent ASRM Committee Opinion on IVM declaring IVM non-experimental (10). In the last decade, IVM protocols have improved, particularly with the development of biphasic IVM culture accounting for better pregnancy and live birth rates (11). Alternatives to IVF, such as IVM, often receive limited attention in clinical practice and research due to

insufficient evidence regarding their efficacy in specific patient populations. Notably, when IVF is performed during a follow-up visit after an unstimulated IVM cycle, it can result in pregnancy outcomes comparable to those of an initial IVF cycle without negatively impacting subsequent pregnancy outcomes (12). Mostinckx et al. in their paper evaluate the size of the efficiency gap between IVM and OS followed by IVF in predicted hyper responders, across a range of serum AMH cut-off levels. They concluded that in sub fertile women eligible for ART, IVM and ovarian stimulation (OS) demonstrated similar reproductive outcomes in those with serum AMH levels ≥ 10 ng/ml (13). With currently available IVM systems, clinical outcomes are lower than those after conventional ovarian stimulation in most women, but for some infertile women

and after appropriate counselling, the improved safety and a simplified clinical approach will outweigh lower efficacy (9).

Major IVM Protocols: Advantages and Disadvantages

In vitro maturation (IVM) of oocytes has evolved into a viable assisted reproductive technology (ART), offering an alternative to conventional ovarian stimulation methods. Various IVM protocols have been developed, each with distinct advantages and limitations. Based on the literature review, the following section provides a detailed overview of major IVM protocols, focusing on their respective benefits and drawbacks.

Standard IVM

The standard IVM protocol is one of the most straightforward techniques for oocyte maturation. A major advantage of this approach is its use of a simple, one-step culture system, which simplifies the laboratory procedure (8, 18). Furthermore, all oocytes begin the maturation process at the same immature meiotic stage, ensuring a uniform starting point for culture (14, 15). However, this approach is not without its disadvantages. The most notable limitation is the relatively low maturation rate, with around 50% of oocytes reaching the metaphase II (MII) stage (15, 16, 17). Additionally, this method yields modest embryo numbers and live birth rates, which can be a concern for patients seeking high success rates in ART procedures (15, 16, 17).

Biphasic IVM

Biphasic IVM represents a more advanced technique, offering several improvements over the standard IVM method. One of the key advantages is the relatively higher MII rates, approximately 70%, compared to the standard approach (18). This increase in maturation rates is accompanied by better embryo yield and live birth outcomes, making biphasic IVM a promising option for ART (17, 18, 19). However, this method does come with its drawbacks. The additional day of culture required for biphasic IVM leads to an increased laboratory burden, potentially complicating the clinical workflow (18). Furthermore, this protocol has only recently been introduced and is limited to a small number of IVM laboratories, which restricts its accessibility and widespread implementation (19, 20).

hCG-Primed IVM

hCG-primed IVM involves the use of human chorionic gonadotropin (hCG) to stimulate oocyte maturation prior to collection. This method is advantageous due to its relatively high MII rates, also around 70% (21). However, the hCG-primed protocol presents a series of challenges. One significant disadvantage is that oocytes are retrieved at various meiotic stages, complicating the consistency of the maturation process (22). Furthermore, this method imposes an additional laboratory burden, as at least two rounds of intracytoplasmic sperm injection (ICSI) are required per oocyte retrieval (OPU) (4). The IVM of germinal vesicle breakdown (GVB) oocytes also tends to be suboptimal, as the extent of their meiotic progression at the start of

culture cannot be precisely determined (22). While this protocol offers relatively high maturation rates, live birth rates remain modest (15, 22). Additionally, hCG-primed IVM is prohibitive for pre-IVM culture approaches, limiting its flexibility in certain ART protocols (23).

Rescue IVM

Approximately 15–30% of oocytes retrieved after ovarian stimulation (OS) are at the metaphase I (MI) or germinal vesicle (GV) stage (30). Rescue IVM is often employed in cases where germinal vesicle (GV) oocytes are present in conventional IVF patients, offering a potential means to improve embryo yield and increase the chances of transfer (24). A key advantage of this approach is its ability to generate additional embryos for transfer, potentially benefiting patients with limited oocyte availability. However, the rescue IVM protocol has several significant disadvantages. Oocytes in this cohort are often associated with meiotic defects, leading to lower-quality outcomes (25). Moreover, IVM without the support of cumulus cells, which is typical in rescue IVM, results in poor oocyte quality and diminished maturation potential (26, 27, 28). Concerns regarding the safety of rescue IVM have also been raised, further questioning its widespread use in clinical practice (28, 29).

Why IVM and Who Is It For?

In vitro maturation (IVM) offers an alternative to traditional ovarian stimulation (OS), which involves significant hormone use. One of the primary advantages of IVM is its reduced reliance on hormones, which has several

benefits for patients. These include avoiding ovarian hyperstimulation syndrome (OHSS) and other complications related to OS, reducing the cost of medications and care, and increasing convenience due to fewer injections and examinations (31, 32). Additionally, IVM places less emotional burden on patients by minimizing the number of invasive procedures.

While IVM has largely been replaced by IVF/ICSI antagonist cycles that use GnRH agonists and a "freeze-all" strategy, it continues to be a focus of research due to its potential benefits and new indications, such as fertility preservation (31). IVM may also serve as a viable option for women at risk for OHSS, including those with polycystic ovary syndrome (PCOS) or polycystic ovarian (PCO)-like ovaries.

Candidates for IVM

Women with PCOS, a common endocrine condition affecting approximately 10% of women, are among the most suitable candidates for IVM. PCOS patients often have high numbers of immature oocytes, which compensates for IVM's lower efficiency compared to conventional OS for IVF (33,34). Many women with PCOS experience excessive responses to OS, while others, particularly those with hyperandrogenism or obesity, may have a narrower window for optimal ovarian response. For these women, IVM provides a more controlled approach with reduced monitoring and flexibility in scheduling oocyte retrieval. After counselling, many women with PCOS may choose IVM as a less burdensome ART option.

Moreover, Anti-Müllerian hormone (AMH) levels, which correlate with the

severity of PCOS, can help predict the success of IVM. For instance, women with the classical PCOS phenotype A, characterized by PCO-like morphology, ovulatory dysfunction, and hyperandrogenism, exhibit the highest AMH levels and are more likely to achieve higher cumulative live birth rates (CLBR) after IVM (35). However, future studies are needed to compare the success rates of IVM and conventional OS in PCOS patients, particularly those with PCOS type A.

IVM for Fertility Preservation

Fertility preservation (FP) is an essential consideration for women who may face fertility threats, such as those undergoing cancer treatments. While conventional OS is the most common approach for FP, it is not feasible for prepubertal girls or women with oestrogen receptor-positive cancers due to the risks posed by hormone treatments. In these cases, IVM, either by collecting oocytes via transvaginal follicular aspiration or extracting them from ovarian tissue, presents a potential option. However, the lower meiotic and developmental potential of IVM oocytes, compared to those retrieved after conventional OS, may impact live birth rates in future use.

The feasibility of IVM for FP has been demonstrated in various cancer patients. Study with 248 breast cancer patients undergoing IVM before neoadjuvant chemotherapy found that IVM resulted in the cryopreservation of a mean of 6.4 mature oocytes per patient. IVM has also been shown to be effective in emergency settings for women diagnosed with

hematologic diseases, where immediate fertility preservation is necessary (36, 37).

IVM for Resistant Ovary Syndrome

Resistant ovary syndrome (ROS), characterized by hypergonadotropic anovulation, is a rare condition that often leads to infertility. For women with ROS, IVM is currently the only viable alternative to egg donation, with several live births reported following this procedure (38, 39).

IVM for Poor Responders

Women who exhibit a poor response to OS, particularly those of advanced reproductive age or with low ovarian reserve, face challenges in achieving pregnancy. Although high doses of gonadotropins have not been shown to improve outcomes for poor responders, IVM has been explored as an option. However, IVM has limited success in poor prognosis patients due to the unpredictable retrieval of immature oocytes and the lower maturation rates (around 50%) associated with IVM (40). Consequently, poor responders may not be ideal candidates for IVM.

IVM for Women with Oocyte Maturation Defects

Some infertile women experience oocyte meiotic maturation defects, in which immature oocytes are retrieved even after conventional OS cycles. For these women, IVM is currently one of the few available treatment options. While some patients show promising results, others have genetic defects that may not respond to IVM, leading to disappointing outcomes. Future improvements in IVM protocols, such as the use of biphasic systems, may offer hope for these patients, particularly in

inducing meiosis in vitro during the maturation phase (23).

DISCUSSION

In vitro maturation of oocytes (IVM) has gained recognition as a valuable technique for minimizing the risk of ovarian hyperstimulation syndrome (OHSS), especially in women with polycystic ovary syndrome (PCOS) and those preserving fertility prior to oncological treatments. While challenges related to oocyte quality remain, recent advancements have enhanced pregnancy success rates as well as neonatal and infant health outcomes (41). IVM has become a promising method for maturing immature oocytes, with applications in IVF, PCOS treatment, and fertility preservation for cancer patients. Advances have improved pregnancy rates and outcomes, yet its clinical adoption remains limited, prompting further research to optimize protocols and broaden its use (42). This technique has been applied beyond PCOS patients to include fertility preservation in cases where ovarian stimulation is contraindicated or time-limited, as well as for poor responders. Collectively, IVM seems a viable option for some ART patients, with specific indications, by reducing the burden and risks of ovarian stimulation (11).

This narrative review was based on a qualitative synthesis of available literature retrieved primarily through PubMed, focusing on studies published in English between 2014 and 2024. While this approach enabled a focused evaluation of current advancements in IVM, it is limited by the exclusion of non-English studies and potential publication bias inherent in

narrative reviews. Moreover, the heterogeneity of included study designs restricts the ability to generalize findings or conduct meta-analytical comparisons.

Future research should aim to validate emerging IVM protocols through large-scale, multicentre clinical trials and standardized outcome reporting. In particular, investigations into embryo yield optimization, improved oocyte recovery methods, and integration of patient-friendly clinical workflows will be essential for establishing IVM as a standard ART modality.

Additionally, the development of zero-stimulation ART methods could revolutionize assisted reproduction by minimizing or eliminating the need for ovarian stimulation. As research progresses, IVM has the potential to become an essential component of assisted reproductive technologies, providing accessible and less burdensome solutions for patients seeking fertility treatments.

REFERENCES

1. Steptoe PC, Edwards RG. Birth after the reimplantation of a human embryo. *Lancet* 1978; 2:366.
2. Cha KY, Koo JJ, Ko JJ, Choi DH, Han SY, Yoon TK. Pregnancy after in vitro fertilization of human follicular oocytes collected from non-stimulated cycles, their culture in vitro and their transfer in a donor oocyte program. *Fertil Steril* 1991; 55:109–113.
3. Edwards RG. Maturation in vitro of human ovarian oocytes. *Lancet*. 1965; 2:926–29.
4. De Vos M, Smits J, Thompson JG, Gilchrist RB. The definition of IVM is

- clear-variations need defining. *Hum Reprod*. 2016; 31:2411–5.
5. Trounson A, Gosden R, Eichenlaub-Ritter U, editors. *Biology and pathology of the oocyte*. 2nd ed. Cambridge: Cambridge University Press; 2013. p. 213. doi: 10.1017/CBO9781139135030.
6. Reinblatt SL, Son WY, Shalom-Paz E, Holzer H. Controversies in IVM. *J Assist Reprod Genet* 2011; 28:525–530.
7. Seyhan A, Ata B, Son WY, Dahan MH, Tan SL. Comparison of complication rates and pain scores after transvaginal ultrasound-guided oocyte pickup procedures for in vitro maturation and in vitro fertilization cycles. *Fertil Steril* 2014; 101:705–709.
8. Practice Committees of the American Society for Reproductive Medicine, the Society of Reproductive Biologists and Technologists, and the Society for Assisted Reproductive Technology. In vitro maturation: A committee opinion. *Fertil Steril*. 2021; 115:298–304
9. De Vos M, Grynberg M, Ho TM, Yuan Y, Albertini DF, Gilchrist RB. Perspectives on the development and future of oocyte IVM in clinical practice. *J Assist Reprod Genet*. 2021 Jun;38(6):1265-1280. doi: 10.1007/s10815-021-02263-5
10. Practice Committees of the American Society for Reproductive Medicine, the Society of Reproductive Biologists and Technologists, and the Society for Assisted Reproductive Technology. In vitro maturation: a committee opinion. *Fertil Steril*. 2021 Feb;115(2):298-304. doi: 10.1016/j.fertnstert.2020.11.018. Epub 2020 Dec 24. PMID: 33358333.
11. Rodrigues P, Marques M, Manero JA, Marujo MD, Carvalho MJ, Plancha CE. In vitro maturation of oocytes as a laboratory approach to polycystic ovarian syndrome (PCOS): From oocyte to embryo. *WIREs Mech Dis*. 2023 May-Jun;15(3): e1600. doi: 10.1002/wsbm.1600.
12. Xu YL, Guo W, Hao YX, Yang S, Li R, Zheng XY, Qiao J. Outcomes of subsequent IVF cycles among women with PCOS after the first unstimulated IVM treatment: a single-center matched retrospective case-control study. *J Matern Fetal Neonatal Med*. 2024 Dec;37(1):2425756. doi: 10.1080/14767058.2024.2425756.
13. Mostinckx L, Goyens E, Mackens S, Roelens C, Boudry L, Uvin V, Segers I, Schoemans C, Drakopoulos P, Blockeel C, De Vos M. Clinical outcomes from ART in predicted hyperresponders: in vitro maturation of oocytes versus conventional ovarian stimulation for IVF/ICSI. *Hum Reprod*. 2024 Mar 1;39(3):586-594. doi: 10.1093/humrep/dead273.
14. Edwards RG. Maturation in vitro of mouse, sheep, cow, pig, rhesus monkey and human ovarian oocytes. *Nature*. 1965;208:349–51.
15. Fadini R, Canto MBD, Renzini MM, Brambillasca F, Comi R, Fumagalli D, et al. Effect of different gonadotrophin priming on IVM of oocytes from women with normal ovaries: a prospective randomized study. *Reprod Biomed Online*. 2009;19:343–51.
16. Mikkelsen AL, Lindenberg S. Benefit of FSH priming of women with PCOS to the in vitro maturation procedure

and the outcome: a randomized prospective study. *Reproduction*. 2001;122:587–92.

17. Vuong LN, Le AH, Ho VNA, Pham TD, Sanchez F, Romero S, et al. Live births after oocyte in vitro maturation with a prematuration step in women with polycystic ovary syndrome. *J Assist Reprod Genet*. 2020;37:347–57.

18. Sanchez F, Lolicato F, Romero S, De Vos M, Van Ranst H, Verheyen G, et al. An improved IVM method for cumulus-oocyte complexes from small follicles in polycystic ovary syndrome patients enhances oocyte competence and embryo yield. *Hum Reprod*. 2017;32:2056–68.

19. Vuong LN, Ho VNA, Ho TM, Dang VQ, Phung TH, Giang NH, et al. In-vitro maturation of oocytes versus conventional IVF in women with infertility and a high antral follicle count: a randomized non-inferiority controlled trial. *Hum Reprod*. 2020;35:2537–47.

20. Kirillova A, Bunyaeva E, Van Ranst H, Khabas G, Farmakovskaya M, Kamaletdinov N, et al. Improved maturation competence of ovarian tissue oocytes using a biphasic in vitro maturation system for patients with gynecological malignancy: a study on sibling oocytes. *J Assist Reprod Genet*. 2021.

21. Ho VNA, Pham TD, Le AH, Ho TM, Vuong LN. Live birth rate after human chorionic gonadotropin priming in vitro maturation in women with polycystic ovary syndrome. *J Ovarian Res*. 2018;11:70.

22. Son WY, Chung JT, Chian RC, Herrero B, Demirtas E, Elizur S, et al. A 38 h interval between hCG priming and oocyte retrieval increases in vivo and in vitro oocyte maturation rate in

programmed IVM cycles. *Hum Reprod*. 2008;23:2010–6.

23. Gilchrist RB, Luciano AM, Richani D, Zeng HT, Wang X, Vos MD, et al. Oocyte maturation and quality: role of cyclic nucleotides. *Reproduction*. 2016;152:R143–57.

24. Veeck LL, Wortham JW Jr, Witmyer J, Sandow BA, Acosta AA, Garcia JE, et al. Maturation and fertilization of morphologically immature human oocytes in a program of in vitro fertilization. *Fertil Steril*. 1983;39:594–602.

25. Nogueira D, Staessen C, Van de Velde H, Van Steirteghem A. Nuclear status and cytogenetics of embryos derived from in vitro-matured oocytes. *Fertil Steril*. 2000;74:295–8.

26. Gilchrist RB. Recent insights into oocyte-follicle cell interactions provide opportunities for the development of new approaches to in vitro maturation. *Reprod Fertil Dev*. 2011;23:23–31.

27. Conti M, Franciosi F. Acquisition of oocyte competence to develop as an embryo: integrated nuclear and cytoplasmic events. *Hum Reprod Update*. 2018;24:245–66.

28. Jones GM, Cram DS, Song B, Magli MC, Gianaroli L, Lacham-Kaplan O, et al. Gene expression profiling of human oocytes following in vivo or in vitro maturation. *Hum Reprod*. 2008;23:1138–44.

29. Jie H, Zhao M, Alqawasmeh OAM, Chan CPS, Lee TL, Li T, et al. In vitro rescue immature oocytes - a literature review. *Hum Fertil (Camb)*. 2021:1–20.

30. Astbury P, Subramanian GN, Greaney J, Roling C, Irving J, Homer HA. The Presence of Immature GV- Stage

- Oocytes during IVF/ICSI Is a Marker of Poor Oocyte Quality: A Pilot Study. *Med Sci (Basel)*. 2020 Jan 16;8(1):4. doi: 10.3390/medsci8010004.
31. Trounson A, Wood C. A Kausche. In vitro maturation and the fertilization and developmental competence of oocytes recovered from untreated polycystic ovarian patients. *Fertil Steril*. 1994;62:353–62.
 32. Ioannidou PG, Bosdou JK, Lainas GT, Lainas TG, Grimbizis GF, Kolibianakis EM. How frequent is severe ovarian hyperstimulation syndrome after GnRH agonist triggering in high-risk women? A systematic review and meta-analysis. *Reprod BioMed Online*. 2021;42:635–50.
 33. Guzman L, Ortega-Hrepich C, Polyzos NP, Anckaert E, Verheyen G, Coucke W, et al. A prediction model to select PCOS patients suitable for IVM treatment based on anti-Mullerian hormone and antral follicle count. *Hum Reprod*. 2013;28:1261–6.
 34. Siristatidis C, Sergeantanis TN, Vogiatzi P, Kanavidis P, Chrelias C, Papantoniou N, et al. In Vitro maturation in women with vs. without polycystic ovarian syndrome: a systematic review and meta-analysis. *PLoS One*. 2015;10:e0134696.
 35. Mackens S, Pareyn S, Drakopoulos P, Deckers T, Mostinckx L, Blockeel C, et al. Outcome of in-vitro oocyte maturation in patients with PCOS: does phenotype have an impact? *Hum Reprod*. 2020;35:2272–9.
 36. Grynberg M, Poulain M, le Parco S, Sifer C, Fanchin R, Frydman N. Similar in vitro maturation rates of oocytes retrieved during the follicular or luteal phase offer flexible options for urgent fertility preservation in breast cancer patients. *Hum Reprod*. 2016;31:623–9.
 37. Sonigo C, Bajeux J, Boubaya M, Eustache F, Sifer C, Levy V, et al. In vitro maturation is a viable option for urgent fertility preservation in young women with hematological conditions. *Hematol Oncol*. 2020;38:560–4.
 38. Galvao A, Segers I, Smits J, Tournaye H, De Vos M. In vitro maturation (IVM) of oocytes in patients with resistant ovary syndrome and in patients with repeated deficient oocyte maturation. *J Assist Reprod Genet*. 2018;35:2161–71.
 39. Li Y, Pan P, Yuan P, Qiu Q, Yang D. Successful live birth in a woman with resistant ovary syndrome following in vitro maturation of oocytes. *J Ovarian Res*. 2016;9:54.
 40. Nogueira D, Sadeu JC, Montagut J. In vitro oocyte maturation: current status. *Semin Reprod Med*. 2012;30:199–213.
 41. Morato ALC, Verruma CG, Furtado CLM, Dos Reis RM. In vitro maturation of oocytes: what is already known?†. *Biol Reprod*. 2025 Jan 14;112(1):18-30. doi: 10.1093/biolre/ioae147. Erratum in: *Biol Reprod*. 2025 Feb 14;112(2):415. doi: 10.1093/biolre/ioae177..
 42. Torkashvand H, Shabani R, Amiri I, Darakhshan R, Maleki B, Doostabadi MR, Mehdizadeh M. Exploring the Potential of In vitro Maturation (IVM) of Oocytes: Indications, Applications, and Treatment Protocols. *Avicenna J Med Biotechnol*. 2024 Jul-Sep;16(3):156-164. doi: 10.18502/ajmb.v16i3.15741.

NAPREDAK I KLINIČKE IMPLIKACIJE IN VITRO ZRENJA OOCITA U ASISTIRANIM REPRODUKTIVNIM TEHNOLOGIJAMA: SVEOBUH VATAN PREGLED PROTOKOLA, PRIMJENA I BUDUĆIH PERSPEKTIVA

Asad Herić 

Klinika za ginekologiju i porodništvo, Sveučilišna klinička bolnica Mostar, 88 000 Mostar, Bosna i Hercegovina

SAŽETAK

In vitro maturacija (IVM) pojavila se kao obećavajuća alternativa konvencionalnoj in vitro oplodnji (IVF), naročito za pacijentice sa sindromom policističnih jajnika (PCOS) i one koje zahtevaju očuvanje plodnosti, poput pacijenata sa rakom. Za razliku od tradicionalnog IVF-a, IVM ne zavisi od intenzivne stimulacije jajnika, čime se smanjuje rizik od sindroma hiperstimulisanja jajnika (OHSS) i nudi pacijentima pristupačniji metod sa manjim brojem injekcija i procedura. Ovaj narativni pregled procenjuje nedavne napretke u IVM-u, fokusirajući se na različite protokole, uključujući standardni, bifazni i hCG-primed IVM, zajedno sa njihovim prednostima i izazovima. Dodatno, pregled razmatra kliničku primjenu, etičke aspekte i ekonomske faktore, naglašavajući potencijal IVM-a za poboljšanje ishoda za pacijente uz minimiziranje opterećenja liječenjem. Uprkos izazovima kao što su niže stope zrelosti jajnih ćelija i varijabilan uspjeh kod pacijentica sa smanjenim odgovorom na stimulaciju, IVM je pokazao obećavajuće rezultate za specifične populacije pacijenata, uključujući one sa defektima zrelosti jajnih ćelija, rezistentnim sindromom jajnika (ROS) i one sa rizikom od OHSS-a. Iako je klinička primjena još uvek ograničena, buduća istraživanja usmjerena na poboljšanje protokola, poboljšanje oporavka jajnih ćelija i proširenje indikacija za IVM mogli bi dodatno integrisati ovu tehniku u asistiranje reproduktivne tehnologije (ART), čineći je ključnim alatom za očuvanje plodnosti i optimizaciju ART-a.

Ključne riječi: in vitro zrijeenje (IVM); asistiranje reproduktivne tehnologije (ART); zrijeenje oocita; policistični jajnici (PCOS); očuvanje plodnosti.

Autor za korespondenciju: Asad Herić, asadheric@yahoo.com

POSTOPERATIVE SEEDING OF LARYNGEAL SQUAMOUS CELL CARCINOMA: A CASE REPORT

Branko Krišto^{1,2}, Ivana Vidović¹, Ana Vukoja¹, Mirko Maglica^{1,2}

¹Cantonal Hospital Livno, 80 101 Livno, Bosnia and Herzegovina

²School of Medicine, University of Mostar, 88 000 Mostar, Bosnia and Herzegovina

Received on 20.8.2025.

Reviewed on 25.9.2025.

Accepted on 11.11.2025.



ABSTRACT

Introduction: Surgical manipulation of malignant tumors can lead to the detachment of cancer cells and their dissemination into the surrounding interstitial fluid, vasculature, or along the tract of biopsy needles, potentially resulting in implantation and secondary tumor growth, also known as tumor seeding. Although squamous cell carcinoma (SCC) is among the most prevalent malignancies of the head and neck region, reported cases of tumor seeding in SCC of the larynx remain exceedingly rare. Nevertheless, this possibility should be continually considered to mitigate adverse outcomes and further enhance the safety and effectiveness of surgical interventions.

Case presentation: A 68-year-old male patient was diagnosed with squamous cell carcinoma (SCC) of the left vocal cord and subsequently underwent left-sided cordectomy. Due to positive surgical margins on histopathological examination, adjuvant radiotherapy was administered, achieving clinical remission as confirmed by direct laryngoscopy and multislice spiral computed tomography (MSCT) scans. However, three months post-radiotherapy, a small tumor mass was clinically identified at the laryngofissure incision site and was confirmed histologically as SCC. No intralaryngeal lesions or other locoregional pathology were detected on further evaluation. The lesion was interpreted as postoperative tumor seeding and was surgically excised, with no evidence of recurrence during one year of follow-up.

Conclusion: Laryngeal squamous cell carcinoma possesses the potential for postoperative seeding, underscoring the importance of adhering to fundamental oncologic surgical principles. Additionally, the role of prophylactic measures against tumor seeding, and the exploration of the tumor microenvironment that facilitates such dissemination, merit further investigation.

Keywords: squamous cell carcinoma of head and neck; neoplasm seeding; laryngectomy; recurrence; radiotherapy

Corresponding author: Mirko Maglica, MD; mirko.maglica@mef.sum.ba

INTRODUCTION

Fine-needle aspiration, biopsy, and surgical excision remain indispensable tools for the diagnosis, treatment planning, and management of solid tumors, aimed at either curative intent or life-prolongation. Despite their therapeutic benefits, increasing clinical and experimental evidence suggests that surgical trauma associated with these procedures can provoke local and systemic responses that potentially enhance tumor progression and metastasis (1-5).

These interventions may facilitate tumor cell release and dissemination into the circulation or adjacent healthy tissues. Altered immune responses and reparative mechanisms can then promote malignant behavior, survival, and extravasation of circulating tumor cells (6, 7). Curran et al. even demonstrated the presence of SCC cells in surgical glove rinses and instrument washings, prompting recommendations to replace gloves and instruments after tumor excision as part of standard oncologic surgical protocols (8).

Although such adverse outcomes might contribute to tumor progression and dissemination, they are exceptionally rare and should not deter surgical intervention, which remains a cornerstone of curative treatment. Nevertheless, these risks warrant attention to further optimize patient safety.

Laryngeal squamous cell carcinoma (LSCC) is one of the most common cancers of the head and neck, with an incidence of 2.76 cases per 100,000 population annually, a prevalence of 14.33 cases per 100,000, and a mortality rate of 1.66 per 100,000 (9, 10). For 2024, approximately 12,650 new cases and 3,880 related deaths are projected (11).

The most significant prognostic factors in LSCC are metastasis and locoregional recurrence. Metastatic spread predominantly involves locoregional lymphatics, accounting for the majority of recurrences. Distant metastases via hematogenous routes, mainly to the lungs, bones, and liver, are less frequent and typically occur within two years of diagnosis. Locoregional recurrences are usually observed within the first year (12-14). Seeding of LSCC remains exceedingly rare, with only six cases reported in the PubMed database. Two of these involved gastrointestinal tract seeding, another two involved tracheal seeding, and merely two cases involved subcutaneous dissemination (12, 15). Therefore, we present an additional rare case of glottic LSCC with subcutaneous tumor seeding.

The aim of this article is to present a rare case of postoperative subcutaneous seeding of laryngeal squamous cell carcinoma following cordectomy and to highlight the clinical implications of this phenomenon.

CASE PRESENTATION

A 68-year-old man presented with a suspicious lesion and was diagnosed with squamous cell carcinoma of the left vocal cord (T1N0M0). He underwent left-sided cordectomy in July 2023 following preliminary tracheotomy. Histopathology revealed a positive surgical margin. Postoperative MSCT of the larynx showed no residual disease or cervical lymphadenopathy (Figure 1). Consequently, adjuvant radiotherapy was administered using a standard conformal technique (3D-CRT/IMRT) with conventional fractionation (2 Gy per fraction, five days per week), delivering a

total dose of 63 Gy to the laryngeal region

over September to November 2023.

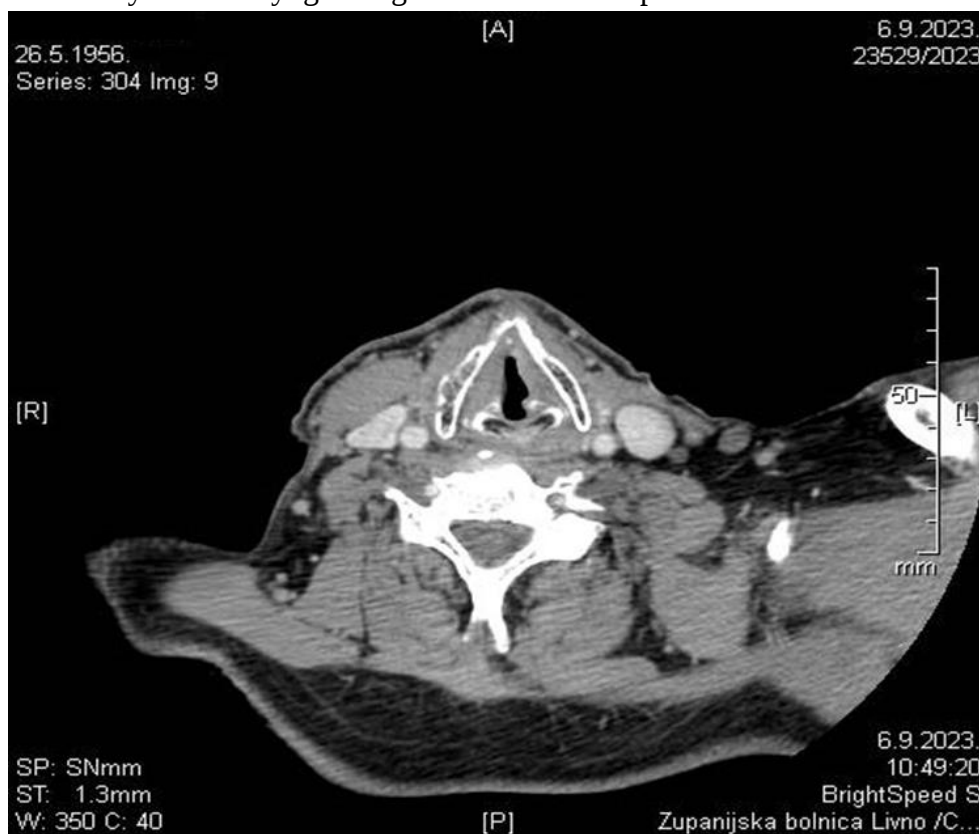


Figure 1. MSCT imaging of the larynx after left-sided cordectomy (showing postoperative scar tissue without visible signs of tumor)

In January 2024, during routine follow-up, a small nodular skin lesion was identified at the laryngofissure incision site, initially presumed to be a pyogenic granuloma. Ongoing monitoring revealed progressive changes, prompting biopsy, which confirmed SCC. Imaging with MSCT

revealed a lobulated mass measuring 30 × 20 mm, located ventrally and subcutaneously, extending to the dermis, without evidence of thyroid cartilage invasion or cervical lymphadenopathy. No residual or recurrent disease was observed at the vocal cords (Figures 2 and 3).



Figure 2. MSCT imaging of the larynx after left-sided cordectomy and postoperative radiotherapy. The recurrent tumor is visible (arrow), with surface ulceration, consistent with tumor seeding.



Figure 3. MSCT imaging of the recurrent tumor (arrow), showing intact thyroid cartilage and a normal intralaryngeal finding.

Surgical resection was indicated, and the patient underwent total laryngectomy with

complete tumor excision (Figure 4).

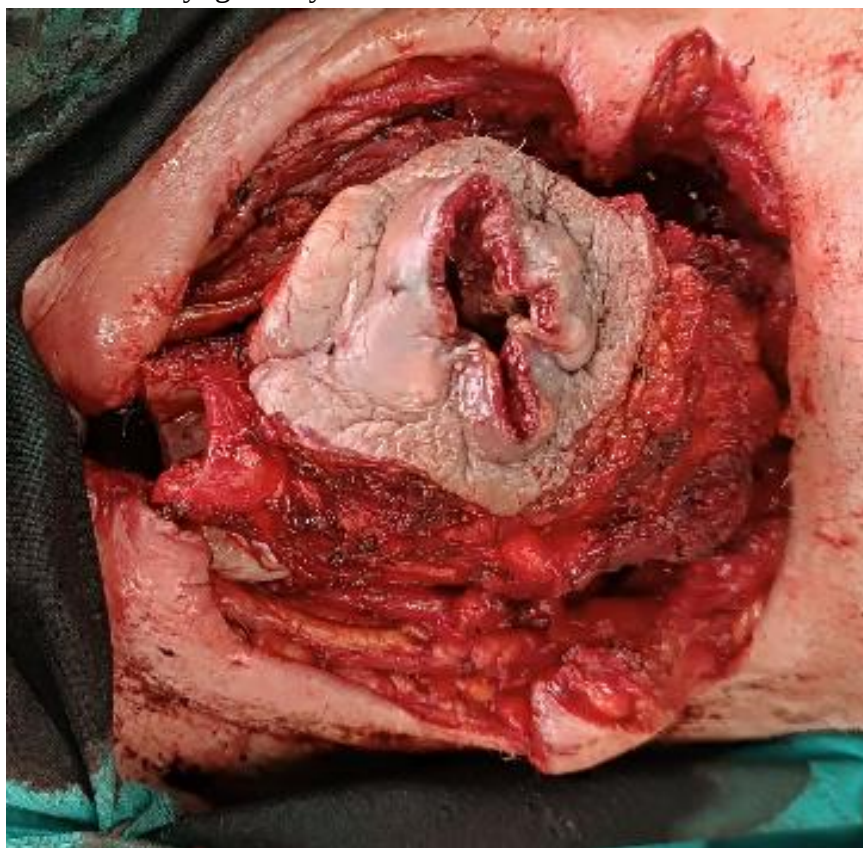


Figure 4. Intraoperative view of the recurrent tumor, showing the entire lesion with marked skin incision margins and tracheal transection in preparation for total laryngectomy (centrally ulcerated recurrent tumor)

Intraoperatively, no evidence of tumor was found at the original vocal cord site, where postoperative scarring and intact mucosal healing were observed (Figure 5). Histopathology confirmed complete

excision of SCC, with intact laryngeal cartilages and no neoplastic changes in the previously treated vocal cord area.



Figure 5. Intralaryngeal view of the larynx following total laryngectomy and removal of the recurrent tumor (arrow indicating the site of the previous corpectomy with intact epithelialization and postoperative scarring, without evidence of residual tumor)

Written informed consent was obtained from the patient for publication of this case report and accompanying images. The patient reviewed the report prior to submission.

DISCUSSION

For most solid tumors, complete surgical resection remains the cornerstone of treatment. However, even extensive resections may occasionally result in local dissemination of tumor cells, which under certain circumstances can evolve into clinically apparent tumors. Laryngeal squamous cell carcinoma most frequently spreads to regional lymph nodes, while

distant metastases are less common and subcutaneous seeding is exceptionally rare. To date, only a handful of cases of postoperative seeding in LSCC have been reported. Jiang et al. described a case of subcutaneous implantation occurring along the surgical tract, highlighting the potential for tumor cell displacement during surgery despite the absence of recurrence at the primary tumor site (12). Similarly, case reports of unusual dissemination patterns emphasize the need for strict adherence to oncologic surgical principles and consideration of prophylactic measures (1). Positive surgical margins are among the most important predictors of recurrence in

early glottic carcinoma. Ansarin et al. demonstrated that patients with positive margins after transoral laser microsurgery had significantly worse local control rates, underscoring the importance of complete resection (16). Moreover, studies have shown that anterior commissure involvement and deeper cordectomy types are associated with higher recurrence risks (17).

Adjuvant radiotherapy is often indicated when high-risk pathological features are present, such as positive or close margins. Conventional conformal RT or intensity-modulated RT, typically delivered with daily fractions of 2 Gy to a total dose of 60–66 Gy, has been shown to improve local control in selected cases (18). Nevertheless, its efficacy in preventing rare events such as postoperative seeding remains uncertain.

In our case, the development of a subcutaneous recurrence several months after surgery and shortly after adjuvant RT suggests that mechanical dissemination of tumor cells during cordectomy was the most plausible explanation. This emphasizes the need for meticulous surgical technique, careful intraoperative handling, and ongoing postoperative surveillance, even when adjuvant treatment is administered.

CONCLUSION

This case reinforces the need for strict adherence to oncologic surgical principles and raises questions about the efficacy of postoperative radiotherapy in preventing tumor seeding, particularly when administered several months after surgery. Future studies should explore effective prophylactic strategies and the role of the

tumor microenvironment in facilitating dissemination.

REFERENCES

1. Kipnis P, Ramanathan D, Hoehn R, Jethwa AR, Karakla DW, Rohr B, et al. Tumor seeding across specialties: a systematic review. *Front Oncol*. 2024;14:1464767.
2. Alieva M, Margarido AS, Wieleś T, Abels ER, Colak B, Boquetale C, et al. Preventing inflammation inhibits biopsy-mediated changes in tumor cell behavior. *Sci Rep*. 2017;7:7529.
3. McDonald SJ, VanderVeen BN, Bullard BM, Cardaci TD, Madero SS, Chatzistamou I, et al. Surgical wounding enhances pro-tumor macrophage responses and accelerates tumor growth and lung metastasis in a triple negative breast cancer mouse model. *Physiol Rep*. 2022;10:e15497.
4. Kameyama H, Dondapati P, Simmons R, Leslie M, Langenheim JF, Sun Y, et al. Needle biopsy accelerates pro-metastatic changes and systemic dissemination in breast cancer: Implications for mortality by surgery delay. *Cell Rep Med*. 2023;4:101330.
5. Cheng X, Zhang H, Hamad A, Huang H, Tsung A. Surgery-mediated tumor-promoting effects on the immune microenvironment. *Semin Cancer Biol*. 2022;86:408-19.
6. Alieva M, van Rheenen J, Broekman MLD. Potential impact of invasive surgical procedures on primary tumor growth and metastasis. *Clin Exp Metastasis*. 2018;35:319-31.
7. Gu X, Wei S, Lv X. Circulating tumor cells: from new biological insights to clinical practice. *Signal Transduct Target Ther*. 2024;9:226.

8. Curran AJ, Smyth D, Kane B, Toner M, Timon CI. Exfoliated malignant cells in glove and instrument washings following head and neck surgery. *Clin Otolaryngol Allied Sci*. 1996;21:281-3.
9. Nocini R, Molteni G, Mattiuzzi C, Lippi G. Updates on larynx cancer epidemiology. *Chin J Cancer Res*. 2020;32:18-25.
10. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2024;74:229-63.
11. Siegel RL, Giaquinto AN, Jemal A. Cancer statistics, 2024. *CA Cancer J Clin*. 2024;74:12-49.
12. Jiang Y, Cao W, Luo Y, Xu J, Li Y, Li J. Post-Surgery Subcutaneous Seeding of Laryngeal Squamous Cell Carcinoma: A Rare Case. *Case Rep Oncol*. 2021;14:568-72.
13. Kim DH, Kim SW, Han JS, Kim GJ, Basurrah MA, Hwang SH. The Prognostic Utilities of Various Risk Factors for Laryngeal Squamous Cell Carcinoma: A Systematic Review and Meta-Analysis. *Medicina (Kaunas)*. 2023;59.
14. Vlachtsis K, Nikolaou A, Markou K, Fountzilas G, Daniilidis I. Clinical and molecular prognostic factors in operable laryngeal cancer. *Eur Arch Otorhinolaryngol*. 2005;262:890-8.
15. Lee DS, Mohit-Tabatabai MA, Rush BF, Jr., Levine C. Stomal seeding of head and neck cancer by percutaneous endoscopic gastrostomy tube placement. *Ann Surg Oncol*. 1995;2:170-3.
16. Burns CL, Ward EC, Hill AJ, Kularatna S, Byrnes J, Kenny LM. Randomized controlled trial of a multisite speech pathology telepractice service providing swallowing and communication intervention to patients with head and neck cancer: Evaluation of service outcomes. *Head Neck*. 2017;39:932-9.
17. McMains KC, Peel J. Dedicated training in adult education among otolaryngology faculty. *Laryngoscope*. 2014;124(:2693-5.
18. Zhou J, Heng Y, Yang Y, Zhu X, Zhou L, Gong H, et al. Survival outcomes in patients with T3-4aN0M0 glottic laryngeal squamous cell carcinoma and evaluation of postoperative radiotherapy. *Oncol Lett*. 2022;24:434.

POSTOPERATIVNO SIJANJE KARCINOMA PLOČASTIH STANICA GRKLJANA: PRIKAZ SLUČAJA

Branko Krišto^{1,2}, Ivana Vidović¹, Ana Vukoja¹, Mirko Maglica^{1,2}

¹Županijska bolnica Livno, 80 101 Livno, Bosna i Hercegovina

²Medicinski fakultet, Sveučilište u Mostaru, 88 000 Mostar, Bosna i Hercegovina

SAŽETAK

Uvod: Kirurška manipulacija malignim tumorima može dovesti do odvajanja tumorskih stanica i njihove diseminacije u okolnu intersticijsku tekućinu, krvne i limfne žile ili duž kanala biopsijskih igala, što potencijalno može rezultirati implantacijom i sekundarnim rastom tumora, poznatim kao sijanje tumora. Iako je karcinom pločastih stanica (KPS) jedan od najčešćih malignoma u području glave i vrata, prijavljeni slučajevi sijanja KPS-a grkljana iznimno su rijetki. Ipak, ovu mogućnost potrebno je uzimati u obzir radi smanjenja nepovoljnih ishoda i dodatnog povećanja sigurnosti i učinkovitosti kirurških zahvata.

Prikaz slučaja: Muškarac u dobi od 68 godina dijagnosticiran je s karcinomom pločastih stanica lijeve glasnice te je podvrgnut kordektomiji. Zbog pozitivnih kirurških rubova na histopatološkoj analizi, provedena je adjuvantna radioterapija, kojom je postignuta klinička remisija potvrđena direktnom laringoskopijom i MSCT-om. Međutim, tri mjeseca nakon radioterapije na mjestu incizije laringofisure klinički je uočena manja tumorska masa, histološki potvrđena kao KPS. Daljnjom obradom nisu otkrivene intralaringealne lezije niti druga lokoregionalna patologija. Lezija je interpretirana kao postoperativno sijanje tumora te je kirurški odstranjena, pri čemu u jednogodišnjem praćenju nije bilo znakova recidiva.

Zaključak: Karcinom pločastih stanica grkljana može imati potencijal za postoperativno sijanje, što naglašava važnost pridržavanja osnovnih onkoloških kirurških principa. Također, uloga profilaktičkih mjera protiv sijanja tumora i istraživanje tumorskog mikrookoliša koji pogoduje takvoj diseminaciji zaslužuju daljnja istraživanja.

Ključne riječi: karcinom pločastih stanica glave i vrata; sijanje tumora; laringektomija; recidiv; radioterapija

Autor za korespondenciju: Mirko Maglica, dr. med.; mirko.maglica@mef.sum.ba

Health Bulletin is a multidisciplinary scientific journal dedicated to publishing unpublished original scientific, professional and review articles, as well as case reports, reviews, professional notices and a broad range of topics from areas of health care disciplines.

Organization of the Manuscript

Articles and all attachments/appendices are submitted in English, with a mandatory summary in Croatian language. The article should contain up to 15 pages, including pictures, tables and bibliography. It must be written in Microsoft Word and you should use 12pt Times New Roman font throughout the text, 1.5 spacing, and both sides alignment. An original scientific article should contain the following components: introduction, objectives, materials and methods, results, discussion and conclusions. The introduction should briefly indicate the objective of the study and its purpose. The materials and methods should be brief and sufficient and therefore allow the reader to repeat the research. Already known methods are not described but mentioned in the references. The results should be clear and logical, and their relevance should be supported with corresponding statistical methods. The discussion section should include a brief statement of the principal findings, a discussion of the findings in light of other published work dealing with the same or closely related subjects. Conclusions must correspond with the present objectives of the research.

Along with the title, the title page should contain author's full name, institution, address, city and the country of the article.

The abstract, in Croatian and English, should not exceed 250 words. Up to 5 keywords representing the main content of the article should be written underneath the abstract. Tables and pictures should be provided on a separate page. They must have an ordinal number that corresponds with the text, and a heading.

With their consent to publication in the Health Bulletin, the authors inform that they will not publish the same work elsewhere without the permission of the Editorial Board. Authors will not receive monetary compensation for the published article. Along with their work, the authors must submit a cover letter to the relevant Editorial Office, which contains a handwritten statement of all the authors:

1. that the said paper has not been published or accepted for publication in another journal,
2. that the research was approved by the Ethics Commission,
3. that the accepted work becomes the property of the Health Bulletin.

The journal is not paid any fee for submitting the work, translating and publishing the work.

Citation style

Indicate sources in the text and bibliography section in accordance with the Vancouver Citation Style. The citation must be in accordance with the uniform provisions for paper submissions to Biomedical Journals of the International Committee of Medical Journals Editors. References within the text of the article are numbered in Arabic numerals in round brackets in the order they are first used in the text.

The authors are responsible for the accuracy of the references. The headings of the journals must be abbreviated according to the style used in the list of journals indexed for MEDLINE, see: <http://www.nlm.nih.gov/tsd/serials/lji.html>.

Examples

Standard Format for Journal Articles: Indicate the names of all authors unless there are seven or more, in this case indicate the first six followed by et al.

Babić D, Jakovljević M, Martinac M, Šarić M, Topić R, Maslov B. Metabolic syndrome and combat post-traumatic stress disorder intensity: Preliminary findings. *Psychiatr Danub*. 2007;19:68-75.

Marčinko D, Begić D, Malnar Z, Dordević V, Popović-Knapić V, Brataljenović T, et al. Suicidality among veterans suffering from chronic PTSD treated at center for crisis intervention, zagreb university hospital center. *Acta Med Croat*. 2006;60:335-9.

Book or manual: Sadock B, Sadock V. Kaplan & Sadock's Synopsis of Psychiatry 9. ed. Baltimore, Philadelphia: Lippincott Williams and Wilkins; 2003.

Chapter in book: Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. In: Vogelstein B, Kinzler KW, editors. *The genetic basis of human cancer*. New York: McGraw-Hill; 2002. p. 93-113.

Internet: Cancer-Pain.org [Internet]. New York: Association of Cancer Online Resources, Inc.; c2000-01 [updated 2002 May 16; cited 2002 Jul 9]. Available from: <http://www.cancer-pain.org/>.

Foley KM, Gelband H, editors. Improving palliative care for cancer [Internet]. Washington: National Academy Press; 2001 [cited 2002 Jul 9]. Available from: <http://www.nap.edu/books/0309074029/html/>.

For detailed instructions see: http://www.nlm.nih.gov/bsd/uniform_requirements.html

At the end of the article specify the contact information of the lead author or one of the co-authors and specify links for ORCID profiles of all authors.

The paper is submitted to the Editorial Board via the electronic form of the HRČAK OJS (Open Journal Systems) system at the link <https://hrcak.srce.hr/ojs/index.php/zdravstveniglasnik/about/submissions> or another magnetic media to the address: Faculty of Health Studies, University of Mostar (for the journal), Zrinski Frankopana 34, 88 000 Mostar, BiH.

