

BOSNIAN JOURNAL OF HEALTH SCIENCES AND TECHNOLOGIES (BJHST)

Journal of the Discipline for Research and Development
Clinical Center University of Sarajevo





130
GODINA
OD OSNIVANJA
1894 - 2024

**KLINIČKI
CENTAR
UNIVERZITETA
SARAJEVO**

130 GODINA USPJEŠNOG RADA KCUS

**BOSNIAN JOURNAL OF HEALTH
SCIENCES AND TECHNOLOGIES (BJHST)**

Vol. 1, No. 2, 2025

PUBLISHER

Discipline for Research and Development
Clinical Center University of Sarajevo
71 000 Sarajevo, Bolnička 25
Bosnia and Herzegovina

AIMS AND SCOPE

Časopis „Bosnian Journal of Health Sciences and Technologies“ objavljuje originalne naučne radove, stručne, pregledne i edukativne, prikaze slučajeva, recenzije, saopćenja, stručne obavijesti i drugo iz područja zdravstvenih nauka i tehnologija.

Časopis je referalan, prati relevantnu bazu podataka i izlazi tri puta godišnje: januar, maj i septembar.

EDITORIAL OFFICE

Address:

Bosnian Journal of Health Sciences and Technologies (BJHST), Discipline
for Research and Development
Clinical Center University of Sarajevo
71000 Sarajevo, Bolnička 25, Bosnia and Herzegovina
Phone: +387 33 298 514
Phone: +38733298733
Web: www.kcus.ba
bjhsteditorial@gmail.com
Technical secretariat: svjetlana.barosevcic@kcus.ba

ISSN 3029-4347 (Print)

ISSN 3029-4355 (Online)

<https://www.kcus.ba/casopis-bjhst/>

PRINT

Štamparija FOJNICA D.D.

TEHNICAL DIRECTOR

Senad Šabanović

CIRCULATION

150 copies

Glavna i odgovorna urednica

Senada Džebo

Uređivački odbor

Sanko Pandur, Mirsada Čustović,
Samela Zelić, Nusret Salkica, Amer
Ovčina, Adnan Šehić, Aleksandra
Pašić

Tehnički urednici

Hazim Šitkovic
Senada Mujezinović

Lektor i Prevodilac:

Svjetlana Barošević

Internacionalni odbor

Vedrana Vejzović, Švedska
Adriano Friganović, Hrvatska
Biljana Filipović, Hrvatska
Marijana Neuberg, Hrvatska
Erna Alukič, Slovenija
Andrej Fink, Slovenija
Ivanka Adžić, Srbija
Tatjana Stojkoska Krkalović, Srbija
Muhamed Topčagić, BiH
Selma Sinanović, BiH
Gordana Panova, Makedonija

CONTENT

BOSNIAN JOURNAL OF HEALTH SCIENCES AND TECHNOLOGIES (BJHST)

Vol. 1, No. 2, 2025

Editorial

- 1. The Work of Nuns - Nurses Throughout 130 Years Existence of the Clinical Center University of Sarajevo 4**
S. Margareta (Slava) Brnada, Mirsada Čustović, S. Samuela (Kata) Bešker, Senada Džebo, Samela Zelić, Tomislav Kovačević

Original articles

- 1. The Impact of Workload on the Quality of Life of Medical Workers in the Intensive Care Unit 18**
Majda Gazap, Amer Ovčina, Mirsada Čustović, Senada Džebo, Anela Džananović
- 2. Comparison of Microbiological Causative Agents of Pneumonia after Tracheobronchial Suctioning..... 29**
Jasmina Hadžić, Amina Herić, Alma Mizdrak, Senada Džebo, Samela Zelić, Mirsada Čustović
- 3. The Influence of Tradition on the Eating Habits of Patients on Hemodialysis - The Experience of One Center 39**
Vahida Hodžić, Maja Bećarević, Arnela Zec, Azra Džubur, Mevlida Sejdinović
- 4. Assessment of Quality of Life in Patients with Diabetic Foot after Surgical Treatment 46**
Emina Nikšić, Almedina Alihodžić, Elvira Turulja, Almera Borčilo, Žana Macanović, Elma Hrbinja, Samira Gajević
- 5. Evaluation of Sex And Age Effect on the Urinary Albumin/Creatinine Ratio Test 52**
Selvedina Duškan, Aleksandra Pašić, Gogić Dalila, Ermin Begović, Sanela Hajro, Suzana Tihić- Kapidžić

Review articles

- 1. Deep Inspiration Breath Hold Techniques in Radiotherapy Treatment of Breast Cancer 57**
Enis Tinjak, Nusret Salkica, Velda Smajlbegović, Mirjana Ristanić-Beroš, Amil Družić, Branka Metlić
- 2. Health Risks of Genetically Modified Food 70**
Melda Pirić, Aida Ahmed, Senada Džebo, Samela Zelić, Merima Ligata, Franka Matić
- 3. Health Promotion as a Basis for the Prevention of Type 2 Diabetes 76**
Ševala Mujović

Case report

- 1. Education as Prevention of Peristomal/Perifistular Complications: Moisture-Associated Skin Damage Around a Fistula 80**
Elmedina Mrkulić, Alma Hadžić, Elvira Kundo, Elvedina Hodžić

Instructions to authors 87

Uputstvo za autore 89

The Work of Nuns - Nurses Throughout 130 Years Existence of the Clinical Center University of Sarajevo

Rad sestara redovnica - medicinskih sestara kroz 130 godina Kliničkog centra Univerziteta u Sarajevu

S. Margareta (Slava) Brnada^{1*}, Mirsada Čustović², S. Samuela (Kata) Bešker³, Senada Džebo⁴, Samela Zelić⁵, Tomislav Kovačević⁶

¹Clinic of Gastroenterohepathology, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

²Department for Quality and Safety of Healthcare Services, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

³Psychiatric Clinic, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

⁴Head Nurse, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

⁵Clinic of Emergency Medicine, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

⁶University Clinic Inselspital, Bern, Švicarska

***Corresponding author:** S. Margareta (Slava) Brnada, Clinic of Gastroenterohepathology, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina, Email: margibr@gmail.com

ABSTRACT

The work of nuns, especially the Daughters of Charity of St. Vincent de Paul, constitutes an indispensable and deeply humane segment of the hospital system development of in Sarajevo and wider in Bosnia and Herzegovina. Their presence in the National Hospital since 1919 has been marked not only by expertise and discipline, but also by a deep sense for the profession, mercy and service to people in the most difficult moments of their lives.

Throughout the turbulent history of this region - from the Austro-Hungarian period, through the Kingdom of Yugoslavia, World War II, Socialist Yugoslavia, the 1990s war, to the modern era - nuns have remained faithful to their mission: to be with the sick, helpless, wounded, and marginalized. Their role was not limited to nursing people in hospital beds. Nuns were also teachers, cooks, technicians, organizers

of hospital life, and often silent therapists of sick souls.

They made a particularly significant contribution in times when there was a lack of medical staff, equipment and medicines. At that time, through selfless service and faith, the nuns maintained morale and hope not only for the patients, but for the medical staff too. They were often a bridge between health care and spiritual support, bringing dignity to dying, hope for recovery, comfort in suffering and dying.

Nowadays, although in reduced number, nuns still work in healthcare facilities, nursing homes, rehabilitation centers and hospices. Their presence represents continuation of the rich tradition of medical spirituality and humanity in Bosnia and Herzegovina healthcare.

Accordingly, throughout the 130 years of the existence and development of the Clinical Center University of Sarajevo, the work of the nuns should be seen not only as a historical fact, but as a fundamental legacy of values that should be cherished in modern medical practice: sacrifice, compassion, dignity and care for the human beings - physical, mental and spiritual.

SAŽETAK

Rad sestara redovnica, posebno sestara milosrdnica sv. Vinka Paulskog, čini neizostavan i duboko human segment razvoja bolničkog sistema u Sarajevu i šire u Bosni i Hercegovini. Njihova prisutnost u Zemaljskoj bolnici od 1919. godine obilježena je ne samo stručnošću i disciplinom, već i dubokim osjećajem poziva, milosrđa i služenja čovjeku u najtežim trenucima života.

Tokom burne historije ove regije – od Austrougarskog perioda, preko Kraljevine Jugoslavije, Drugog svjetskog rata, socijalističke Jugoslavije, rata 1990-ih pa sve do savremenog doba - redovnice su ostale vjerodostojne svom poslanju: biti uz bolesne, nemoćne, ranjene i marginalizirane. Njihova uloga nije bila ograničena samo na brigu za osobe u bolničkim krevetima. Časne sestre su bile i učiteljice, kuharice, tehničarke, organizatorice bolničkog života, a često i tihi terapeuti bolesničkih duša.

Posebno značajan doprinos dale su u vremenima kada je nedostajalo zdravstvenog kadra, opreme i lijekova. Tada su redovnice, kroz nesebično služenje i vjeru, održavale moral i nadu ne samo pacijentima, već i medicinskom osoblju. Često su bile most između zdravstvene njege i duhovne podrške, unoseći dostojanstvo u umiranje, nadu u ozdravljenje, utjehu u patnji i umiranju.

U današnjem vremenu, iako brojčano smanjene, sestre redovnice i dalje djeluju u zdravstvenim ustanovama, domovima za stare, rehabilitacijskim centrima i hospicijima. Njihova prisutnost predstavlja nastavak bogate tradicije medicinske duhovnosti i

humanosti u bosanskohercegovačkom zdravstvu. Upravo zato, kroz 130 godina postojanja i razvoja Kliničkog centra Univerziteta u Sarajevu, rad sestara redovnica treba posmatrati ne samo kao historijsku činjenicu, već kao temeljno naslijeđe vrijednosti koje se trebaju njegovati i u savremenoj medicinskoj praksi: požrtvovanost, saosjećanje, dostojanstvo i briga za čovjeka u njegovoj cjelini – tjelesnoj, duševnoj i duhovnoj.

INTRODUCTION

The Daughters of Charity are the most numerous active religious community of the Catholic Church. The first community was founded by St. Vincent de Paul in 1633 in Paris.

In 1845, upon an invitation of the Zagreb Archbishop Juraj Haulik, the Daughters of Charity arrived to Zagreb and founded their convent. Immediately upon the arrival and in accordance with the purpose of the Community and needs of the city, they started “teaching children and serving the sick”. Afterwards, they developed their work in social charity institutes, church institutions and religious communities in the territory of the city of Zagreb. Archbishop Haulik considered the monastery to be his doing and attending to its progress and expansion. Over the time, a residential complex was built in the streets of Frankopanska, Varšavska and Gundulićeva, a convent and a school, and the educational work of the Daughters of Charity occurred there for a whole century (1).

Already in 1856, the monastery became an independent Mother House, and for 150 years - from 1845 to 1995 - the Congregation operated in that area in 30 religious communities of various profiles. That activity and three other branches of the Congregation most closely connected to the Mother House - Gradec, Lovrečina and Lućnica - are presented in a book by sisters Berislava Vračić and Alfonza Kovačić entitled “Sisters of Charity I”, published in Zagreb in 1996. Thus, the tree, planted by Cardinal Haulik, branched all over Croatia. Nuns accepted work in schools, hospitals, nursing

homes, penitentiaries, sanatoriums, children's and convalescent homes, orphanages and seminaries (2).

The Sisters of Charity began their work in the "old Turkish" Sarajevo in 1871, and since then they have been persistently doing it until the present day, going through more or less difficult times: the Austro-Hungarian occupation (1878), annexation (1908), the First World War (1914-1918), the old Yugoslavia (1918-1941), the Second World War (1941-1945) and the last war (1992-1995), the consequences of which are still present. In 1871, the Sisters of Charity went to Slovenia, Serbia, Rumelia (the European part of Turkey), Albania, Kosovo, Macedonia and Bulgaria (2).

The Congregation of the School Sisters of St. Francis of Christ the King was established in 1844 thanks to a group of teachers - Franciscan nuns who ran a private school in Graz, Austria. With their activities, they wanted to help poor students who could not afford to pay school fees. They lived together, thus the school manager Antonija Lampel received the church's approval for the community life of these Franciscan nuns, who expressed their willingness to live a monastic way of life. At the invitation of Bishop Slomšek, in 1864, four sisters came to Maribor and took over the leadership of the orphanage and school of the Congregation of Catholic Ladies. Among them was s. Margarita Pucher, who recognized Maribor as a place where the School Sisters could do a lot with their charisma for the upbringing and education of poor youth. Thus, she became the founder of the new congregation, and in 1869 she was appointed Mother Superior (3).

The Franciscan School Sisters of the Province of the Holy Family - Mostar In 1899, at the invitation of Bishop Paškal Buconjić, the sisters came from Maribor to Mostar, where they opened an orphanage. Due to urgent requirements in Bosnia and Herzegovina, they soon establish schools in Mostar, Međugorje, Nevesinje, Trebinje, Čapljina and Lištica. In 1929, they became involved in the work of the Mostar hospital, thus starting their activities in healthcare (3).

The Bosnian-Croatian Province of the Franciscan School Sisters of the Immaculate Heart of Mary

The sisters of this Province came to Bosnia and Herzegovina in 1929 at the invitation of Brother Josip Markušić. They started their activities in Visoko and Sarajevo, taking care of seminary and seminary households. In 1936, they set up a school in Vareš, and despite difficult social circumstances, they continued to establish schools and kindergartens in other places. Since 1973, they have been involved in the work of the Clinical Center in Sarajevo (3).

The Adorers of the Blood of Christ was founded by St. Maria De Mattias (1805 -1866) in Acut (Italy) in 1834. It was the age of numerous wars for political supremacy, the age of turning points in history when many previous values were challenged or disappeared against new trends spreading from the enlightenment centers. The Sisters of Adoration (German branch) first came to Bosnia in 1879, when, after four centuries of Ottoman rule, the administration was taken over by the Austro-Hungarian monarchy. The first sisters Adorers of the Blood of Christ arrived in Banja Luka from the Austrian town of Feldkirch on 7 October 1879, at the invitation of the Trappist prior, Father Franz Pfanner. Initially, they were accommodated in the purchased Turkish blockhouse. The Turkish blockhouse became the first monastery of these sisters who dedicated it to Saint Joseph from Nazareth, later simply referred to as *Nazareth*. Immediately upon arrival, the sisters established an orphanage in the Banja Luka suburb of Budžak, and a school the following year. During more than half a century, from 1880 to 1945, the sisters were engaged in educational work and establishing eleven primary and five secondary girls' schools in Bosnia and Herzegovina. Their schools were known for their quality teaching, various activities, music lessons, handicrafts, and learning foreign languages. In their largest monastery, Nazareth in Banja Luka, they also established an orphanage and a boarding school for students. The extensive educational activity was abruptly interrupted in 1945, when all religious schools were banned and the sisters' property and convents were confiscated (4).

The Sisters Servants of the Little Jesus (SMI), under the safe leadership of the Holy Spirit, was founded on 24 October 1890 in Sarajevo as the life

work of the Archbishop Metropolitan of the Archdiocese of Vrhbosna, Dr Josip Stadler. These sisters have been growing, blooming and being born, faced with many temptations, for 125 years. With the intention to help many poor people, Archbishop Stadler bought a house in the then Mjedenica Street in August 1890 for the welfare of poor people and children. That dilapidated house became the first Archbishop's Almshouse. The house was reconstructed and on the feast of St. Rafaela, on 24 October 1890, it was opened and accommodated several women. Thus, that day was considered the foundation day of the Sisters of the Servants of the Little Jesus (5).

Archbishop Stadler entrusted the care of the poor to a group of six girls, who became the first members of the SMI Congregation after taking their first religious vows in 1893. Archbishop Josip personally wrote the first rules entitling them "*Rules for the Servants of the Poor or Little Jesus*". Eight years later, he built a new large house for the poor in the Sarajevo neighborhood of Bjelave and called it "Bethlehem". The house was occupied by the sisters and children from the first almshouse on Mjedenici Street. That house also became the Mother House of the Congregation. Just a year later, he bought another house for accommodation of the elderly and boys, and named it "Egypt" (5).

The purpose of the Sisters of the Servants of the Little Jesus was to "participate in the life of the Church by caring for the weak brothers of Jesus: the sick, the poor, abandoned children and the elderly". Sisters were involved in the apostolate by taking care of the sick, the weak and the abandoned, caring for them in state nursing homes and homes located next to religious buildings. In state institutions and within monasteries, sisters served children with developmental disabilities and children without parental care, also working as nurses in hospitals and foster homes (5).

THE WORK OF THE DAUGHTERS OF CHARITY IN THE STATE HOSPITAL

Daughters of Charity of St. Vincent de Paul II Congregation Branch

The Daughters of Charity have long been known as professional and responsible workers, especially in matters related to the care of the sick. That was the reason why they were summoned by Dr Milivoje Kostić, Director and Head of the Surgical Department of the Sarajevo Hospital (6).

On 13 January 1919, he sent a letter to the superior of the Congregation, Msgr. Matija Seigerschmied, requesting him to allocate eight to ten nurses to care for patients in the said hospital. The request emphasizes the belief that nurses were excellent caregivers and particularly conscientious with hospital inventory (1).

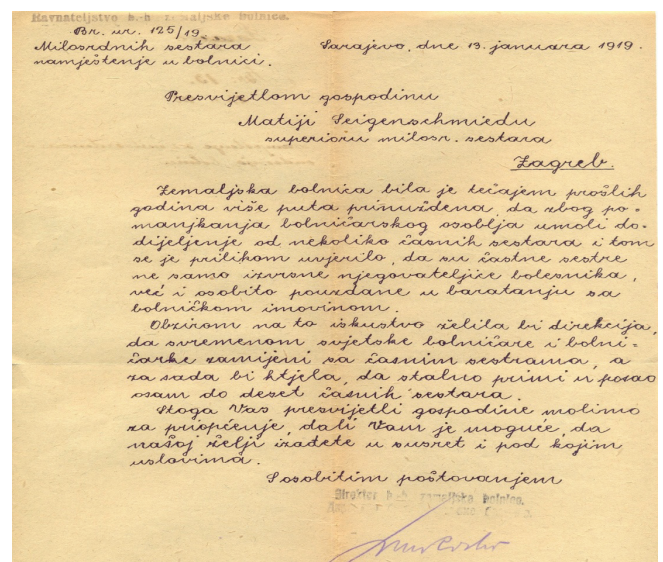


Figure 1 Letter from the hospital director Dr. Milivoje Kostić to Msgr. Matija Seigerschmied requesting allocation of the Sisters of Charity to the BH National Hospital (13.01.1919) – Archives of the Congregation.

Based on a response letter of the Superior Seigerschmied to the Director of the Sarajevo hospital on 27 January 1919, it was visible that the leadership of the Congregation was ready to grant the request. The Congregation immediately drafted the conditions under which the nurses could come and take over the hospital work (7).

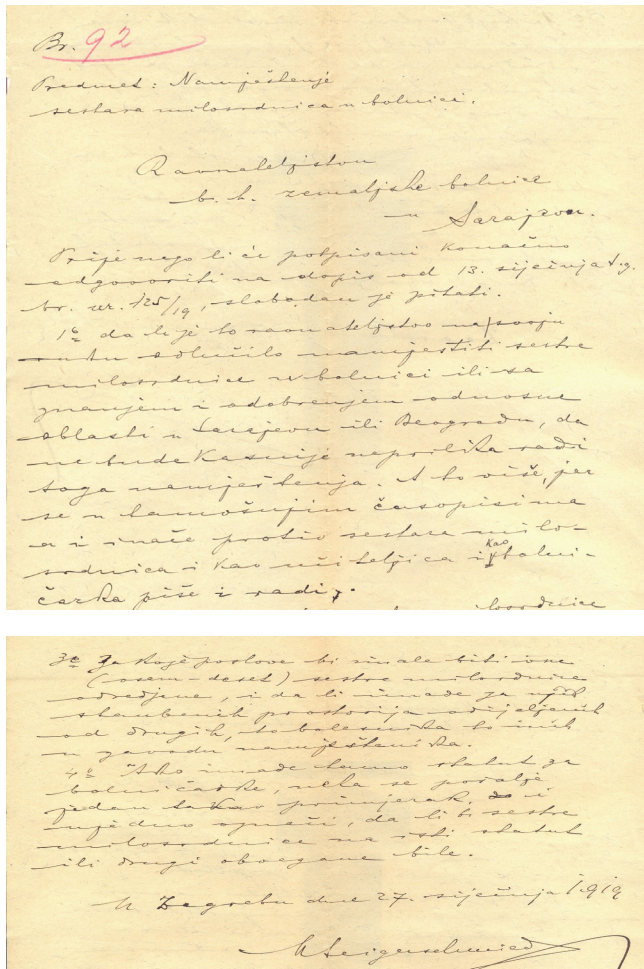


Figure 2 Superior Seigerschmied's reply to the Director of the Sarajevo Hospital from 27 January 1919) - Archives of the Congregation.

Based on the written "Agreement" of both parties, the sisters arrived to the National Hospital in Sarajevo on 13 March 1919. There were 12 of them, and they were accompanied by the superior Msgr. M Seigerschmied. Their first superior was Sister Mirjana Bostijančić (1919 - 1921). The aforementioned "Agreement" resolved all important issues related to the life and work of the sisters at the National Hospital, primarily the issue of the hospital's chaplain, or the hospital chapel. The priest's office was entrusted to Reverend Stjepan Ilić, who became a genuine support to the sisters in all respects, and was also highly regarded by the hospital administration. The "Agreement" resolved the issue of the nurses related

to their accommodation, work uniforms and footwear, laundry, sick leave, and the receipt of an annual reward for each nurse (1,000 krone). It was determined that the sisters had 14 days annual leave to perform their annual spiritual exercises. The rights of the Superior as head of the sisters were also precisely defined (1).

Zapisnik
od 14. marta 1919.
sastavljen kod zemaljske bolnice u Sarajevu.

Na današnjem sastanku i dogovoru postignut je između pres. gospodina Matije Seigerschmieda superiora milosrdnih sestara i gosp. Dr. M. Kostića direktora zem. bolnice u pogledu upotrebe časnih sestara milosrdnica za njegovanje bolesnika ovaj

Sporazum.

- 1) Zemaljska bolnica, imajući namjeru, da postepeno u dijelnoj bolnici povjeri njegu bolesnika časnim sestrama milosrdnicama, prima za sada 10-12 č. sestara za taj posao.
- 2) Č. sestre M. stanovade u zemaljskoj bolnici, u koju svrhu im se predavaju prostorije dosadanje stanice B/C sa potrebnim namještajem za sobu starješice, za zajedničku spavaću sobu i za blagovaonicu. Za kapelicu će namještaj pribaviti č. sestre.
- 3) Hranu će dobivati č. sestre u obimu, u kojem to dobivaju bolničarke, ali će im se hranu napose donositi u njihov stan, gdje će zajednički blagovati.
- 4) Službu će vršiti časne sestre bez prekida, odnijenjujući se međusobno prema njihovoj potrebi. Prekid je dopustiv samo u doba ručka, večere i sa tijekom spojenih pobožnosti, te u doba jutarnje molitve. U to doba treba da na bolesničke po potrebi pripremi koja svjetovna bolničarka. Za poslove kod bolesnika, koje se redovnicama ne dolikuju, upotrebljavat će se svjetovni bolničari odnosno bolničarke.
- 5) Č. sestre mogu se za bolničarsku službu upotrijebiti bilo same za sebe, bilo u zajednici sa svjetovnim bolničarima ili bolničarkama, a uz pretpostavke pođ tačkom 4.
- 6) Č. sestre noseće svoje rublje, odijelo i obuću, a od bolnice će dobiti prema potrebi kecalje ili kapute, ali u bolnici će se prati ne samo te kecalje i kaputi, već
- 7) Za teže i prostije poslove dodijeliće se potreban broj sluga i služavki, napose za donošanje jela i ogrjevnog materijala, za donošanje i odnošenje rublja, za pranje podova i sugja itd.
- 8) Pošto č. sestre načelno ne rade za plaću, već samo za vlastito uzdržavanje, to se kao naknada za obuću i odjeću utvrđuje za sada nagrada od hiljadu kruna godišnje za svaku sestru M. Novac će primati primitak potvrđivati s.m. starješica mjesечно naknadno.
- 9) Za slučaj oboljenja koje č. sestre vrijede ustanove, koje su propisane za svjetovne bolničarke, t.j. pripada za 3 mjeseca bezplatna njega i liječenje, u vremenu za prvi mjesec potpuna novčana nagrada a za drugi mjesec polovina nagrade.
- 10) Č. sestrama pripada pravo da svake godine dobiju za duhovne vježbe dopust od 14 dana, isto izmjenično.
- 11) Starješinstvo č. sestara ovlašteno je da prema potrebi pojedine sestre odnijenji sa drugim ~~se drugim~~ sestrama, obavijestivši o tome bolničku direkciju, ne navagajući tome razloga.

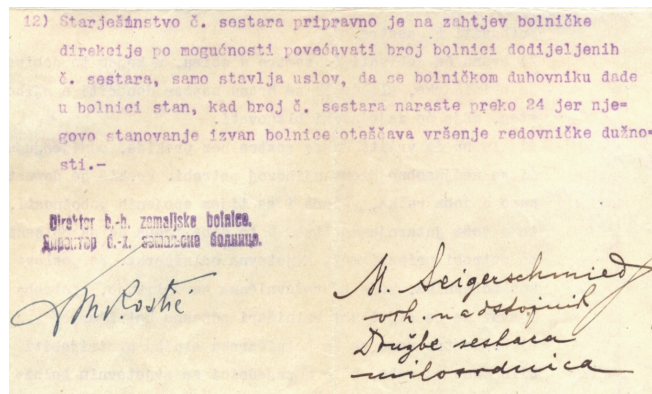


Figure 3 Agreement of 14 March 1919 drawn at the National Hospital in Sarajevo - Archives of the Congregation.

The first nurses worked in surgery and in the outpatient clinic - at the Department of Dr Kostić.

On 29 December of the same year, 12 more sisters arrived at the hospital and began their work at the beginning of 1920. The administration made efforts to have the sisters on as many positions as possible, as they were convinced that they were fully committed to their duties, as expected. However, some hospital staff were disappointed that nurses were taking over. Prioress Sister Mirjana, who in those days of temptation acted beneficently and encouraged her sisters, due to her illness was transferred from Sarajevo already on 24 September 1921, and was replaced by Sister Licinija Štefanić. In the same year, at the request of the hospital administration, five new nurses came to work in the kitchen, which was the subject of particular disagreement with the hospital staff. Unfortunately, disagreement and non-acceptance on the part of the hospital staff lasted for years, contributing to a growing tension.

Such a situation lasted for ten years. When two sisters working in the kitchen were fired on 28 November 1931, the leadership of the Congregation made decision to withdraw all sisters from the hospital kitchen. The hospital administration was also asked to grant the sisters a separate kitchen from 1 December 1931, and to give them the appropriate daily amount of food in kind so that they would no longer disturb anyone. That request was granted. The nurses were

given a separate kitchen, while the hospital kitchen was again staffed by secular staff (8).

Despite all the difficulties and inconveniences, the number of nurses in the hospital grew every year, and always at the request of the hospital administration. Thus, on 9 January 1921, the administration requested the Supreme Administration of the Congregation in Zagreb whether it could be expected to increase the number of sisters to as many as 48 over time. They explained their inquiry by stating that the hospital intended to build a new building for nurses, and it was necessary to know their number for the purpose of calculation drafting. At the beginning of 1922, there were 27 nurses in the hospital community, and in the following years, until 1925, 17 more arrived (1).

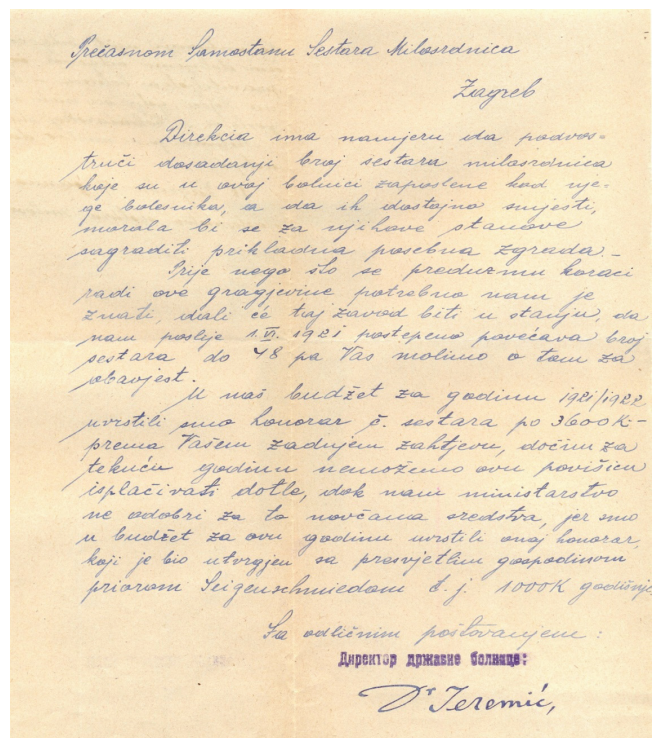


Figure 4 The Director of the State Hospital inquires with the Supreme Administration of the Congregation in Zagreb whether the increase of nurses to 48 in time could be expected - Archives of the Congregation.



Figure 5 Sarajevo Sisters of Mercy with priest Stjepan Ilić - Archives of the Congregation.

The hospital administration kept its word and started the construction of a new building for nurses. In the spring of 1922, the cornerstone for the “Home of the Sisters of Charity” and their chapel was blessed by Msgr. Stjepan Hadrović. Construction progressed quickly and the sisters were able to move in on 26 November 1922. The blessing of the house and the chapel was performed by the Archbishop Dr. Ivan Ev. Šarić. The house’s blessing ceremony was attended by the Reverend Mother Superior Roza Pelikan, from Zagreb, and all the heads and doctors of the hospital, as the heads of the sister communities in Sarajevo (8).



Figure 6 Home of the Daughters of Charity within the National Hospital - Archives of the Congregation.

In 1923 Director Dr. Ivan Jakovljević organized a paramedic training that lasted from December 1923 to June 1924. 15 Daughters of Charity attended the in-service training. The second such course, also organized by the Director Dr. Jakovljević, lasted from March to October 1925, and was attended by 8 Daughters of Charity. After passing exams the sisters were awarded appropriate certificates on both occasions (1).

At the request of the Hospital Administration, 19 more nurses arrived to the Sarajevo Hospital in 1932 and 1933. Until 1931, the legal status of nurses in the hospital was based on the “Agreement” from 1919. In the meantime, in 1926, the Ministry of Health in Zagreb, headed by Dr Katičić drafted a form of contract for all the Daughters of Charity employed in state hospitals. The Ministry sent that form to the administrations of all hospitals where nurses were employed. Thus, the Sarajevo Hospital also received the form, but with the Congregation’s correction regarding the payment of the district treasury for nurses working in hospitals. The agreement between the Ministry of Social Policy and Public Health, represented by the Director of the State Hospital in Sarajevo, Dr. Hamdija Karamehmedović, under the authorization of the Minister from 11 December 1931, and the leadership of the Congregation of the Daughters of Charity St. Vinko Paulovski in Zagreb, represented by the supreme superior, Reverend Mother Ignacija Pavičić, was signed in Sarajevo on 30 December 1931 (1).

Beleg. br. 638-1931.

UGOVOR DRŽAVNE BOLNICE U SARAJEVU

Ministarstva socijalne politike i narodnog zdravlja
Između državne bolnice u Sarajevu, zastupane po.....
Rev. po. Pavičiću Ignaciji, Ministar. Z. br. 143 od 11. XII. 1931. i Nastojstva
Miroslava državne bolnice u Sarajevu, Dr. Hamdija Karamehmedović
i Nastojništva Družbe sestara milosrdnica sv. Vinka Paulskoga u Zagre-
bu, zastupane po vrhovnoj nastojnici časnoj Majci Ignaciji Pavičić,
sklopljen je ovaj ugovor.

§ 1

Sestre milosrdnice sv. Vinka Paulskoga sa kućom maticom u Za-
grebu pružaju u državnoj bolnici u Sarajevu : njega bolesnika, ku-
hinju, inventar u sobama za bolesnike i za sestre, nadzor na sve objek-
te i za bolničke naprave u njima /plinovod, vodovod, elektr.vodovi/ te
čišćenje i čuvanje odjeljenja bolesnika. Ne smiju se upotrebljavati za
službu vratarice, niti smiju pospremati stanove ljekara i kancelarije,
a ne mogu se upotrebljavati ni za obavljajnja prostih i teških posala.

Osobno na duhovni stalež ne mogu se upotrebljavati kod li-
ječenja spolnih bolesti, kod poroda, abortusa upoće za poslove oko
spolovila, koji su zabranjeni društvenim Ustanovama, a za koje postoje
svjetovni bolničari.

§ 2

§ 2

Sestre milosrdnice kao redovnice imaju posebno odjeljenje za stan /kluksuru/ u bolnici sa posebnim i urednim namještajem u koji nitko bez znanja sestara nastojnica ne smije ulaziti.

U slučaju ozbiljnoga oboljenja smještava se sestra redovnica u posebnu sobu.

Sestre dobivaju od bolnice hram određenu po naročitoj Jelovniku, osim toga dobivaju ogrev, rasvjetu, pranje rublja i za svaku sestru 600 Din mjesečnog honorara. Od odijela dobivaju sestre za uporabu kod posla bijele pregače i polurukave, dok sestre bolničarke i kuharice dobivaju osim toga i bijele mantle, kpeje ostaju vlasništvo zavoda.

§ 3

Broj bolničarskog pomoćnog osoblja ustanovljuje uprava bolnice sam a broj redovničkog osoblja sporazumno sa sestrom prestonjicom u okviru odobrenoga bolničkoga proračuna. Premještanje iz jednoga odjeljenja na drugi vrši se dogovorno sa šefovima koji imaju pravo zadržati da se za naročitu struku neprikladna sestra izmijeni. Za bolničarsku službu mjerodavni su propisi Zakona o bolnicama od 27/II 1930 i Pravilnika San.Br.10652 od 16 maja 1930.

§ 4

Uprava bolnice nastojatelj, da svi u bolnici susreću sestre sa onim poštovanjem i obzirom, koje njihovom staležu dolikuje. S druge strane imaju opet i sestre sa svim blago i susretljivo postupati i nastojati da sve osoblje u bolnici bude zadovoljno i vjerno zavodu.

§ 5

Nastojništvo Družbe sestara milosrdnica pridržava si isključivo pravo da imenuje kućnu nastojnicu i namješta i premješta sestre /vidi § 3 ovoga ugovora/ Vrhovna nastojnica obvezana je da po mogućnosti dađe ugovoreni broj sestara. Svaka nova sestra ima se pri dolasku predstaviti upravniku i ekonomu bolnice.

sku predstaviti upravniku i ekonomu bolnice.

§ 6

Za slučaj da koja sestra oboli uslijed bolničke službe, dužna je bolnica da ju kroz vrijeme od 1 mjesec liječi na svoj trošak. Doblje-la ima pravo na nagradu samo do dana nastupa njezine zamjene.

§ 7

Bolnica je dužna da ima kućnu kapelu i da uzdržava jednog katoličkog svećenika, koji će biti ujedno i duhovnik sestara. Ovaj ima u bolnici besplatni stan, a prima mjesečnu nagradu od 1200 Din; hramu ima u bolnici uz režijsku cijenu prema Uredbi o prinaldežnostima u naravi. Sav trošak oko kapele za izvanredne izdatke koji su doduše rijetki, snosi bolnica, dok će sestre obične potrebe kapele namirivati o svoje trošku.

§ 8

Sestre milosrdnice moraju imati dosta vremena za svoje redovničke dužnosti u granicama kućnog reda. Te dužnosti kao i blagovanje

obavljaju sestre izmjenično bilo međusobno ili sa pomoćnim osobljem tako, da njega bolesnika ne trpi i da redoviti poslovi ne zapinju.

Kad sestre vrše noćnu službu prije ili poslije ponoći, imaju pravo na polovicu slobodnoga dana. Da zdravlje sestara i dužna služba ne strada, uprava bolnice treba da se pobrine za dovoljan broj podvornog osoblja u granicama odobrenog proračuna, da im se i po danu može omogućiti izmjenični kraći odmor. Za izmjenu odsutnih kao i bolesnih sestara biće dodjeljena jedna sestra, koja će ujedno zamjenjivati sestru na 0 - 3. Osim nje jedna sestra biće određena za pranje sestarskog rublja, dok će trećoj biti povjerenom dužnost čišćenja i spravljanja sestarskih prostorija i kapele.

§ 9

Sa sestrama milosrdnicama u bolnici upravlja sestra prestonjica. Ako ima uprava bolnice da kojoj sestri odredi koji posebni posao, ili joj naloži koju izvanrednu dužnost, ima da se obrati na prestonjicu, kojoj pripada da sa sestrama ravna. Prestojnica je dužna to upravljati udešiti prema intencijama i želji uprave bolnice, u koliko se ne bi iste kosile sa Statutima Družbe sestara milosrdnica, te se ima držati kod svega propisanog bolničkog Pravilnika i određenih službenih naputaka.

§ 10

Svaka sestra ima u godini pravo na 14 dnevni dopust za duhovne vježbe, i to u vrijeme kada ih vrhovna nastojnica pozove. To bi va izmjenično tako, da služba u bolnici ne strada. Prije toga dopusta ima se najaviti sestra upravi bolnice kao i šta izlaze za vrijeme službe dok se za obične izlaze u grad /zaburu i t.d./ u slobodno vrijeme ima najaviti samo svojoj sestri prestonjici. Za vrijeme dopusta ne odbija se sestrama redovita mjesečna nagrada.

§ 11

Ako bi bilo sestrama skupno ili pojedinoj ugroženo zdravlje ili čudorednost ili povrijeđena redovnička čast uprava se obvezuje da će odmah ukloniti pogibelj. Ako bi se propustilo da se pogibelj ukloni tada će Nastojništvo imati pravo, da bez daljnjega prekine ugovor i opozove sestre uz otkaz od jedan mjesec dana.

Uprava s druge strane ima pravo da zahtjeva od sestara najsavjesnije vršenje propisa za bolničarsku službu.

§ 12

Svaka sestra milosrdnica odgovorna je na svom odjeljenju za povjerenom joj dobro: rublje, živežne namirnice, za njegu, red i čistoću bolesnika i bolesničkih prostorija. Za štete nastale dokazano krivnjom sestara jamči Družba.

Sestre milosrdnice imaju u svakom pogledu štedljivo raditi osobito u rukovanju sa rubljem, lijekovima, živežem i t.d. Jednom riječju imaju u svemu gledati, da sve bude na što veću korist zavoda.

§ 13

Ovaj ugovor sklapa se na nepredviđeno vrijeme, te je svakoj stranci slobodno otkazati ga i ugovoreni otkaz prekinuti uz prethodni otkaz od 6 mjeseci. Obostranim pristankom može se rok otkaza skratiti.

§ 14

Ovaj ugovor stupa na snagu odmah čim bude od obje ugovarajuće stranke odobren i potpisan.

§ 15

Ova se ugovor sastavlja u tri jednaka primjerka, od kojih jedan ide Ministarstvu Socijalne Politike i Narodnog Zdravlja, drugi upravi državne bolnice u Sarajevu, dok se treći pohranjuje u arhivi Družbe sestara milosrdnica sv. Vinka Paulskog u Zagrebu.

U Zagrebu 11. oktobra 1931.
Za Družbu sestara milosrdnica sv. Vinka Paulskog u Zagrebu
Vrhovna nastojnica :



M. Ignacija Pavičić

Po odobrenju Ministra socijalne politike i narodnog zdravlja
Č. br. 22.143 od 11. XII 1931.



30. XI - 1931.
Sarajevo.

Za Ministarstvo socijalne politike i narodnog zdravlja
Upravnik državnih bolnica Sarajeva
M. Hamdija Karamehmedović

Figure 7 The agreement between the Ministry of Social Policy and Public Health, which under the authorization of the Minister from 11 December 1931, was represented by Director of the Sarajevo State Hospital Dr Hamdija Karamehmedović and supreme superior, Reverend Mother Ignacija Pavičić – Archives of the Congregation.

The Agreement was valid until 1938, when the sisters started to be accepted into the service according to the so-called Instructions, published in the Official

Gazette of the Kingdom of Yugoslavia No. 21 of 31 January 1938. It was unchanged until 1941, when the venerable Mother, Tekla Delač, restarted the issue of the Agreement. Given that the management of the hospital expressed readiness for drafting a new agreement, the Supreme Administration sent a draft that was fully approved by the Archbishop of Vrhbosnia, Ivan Ev. Saric. The Agreement was adopted on 24 June 1941 (1).

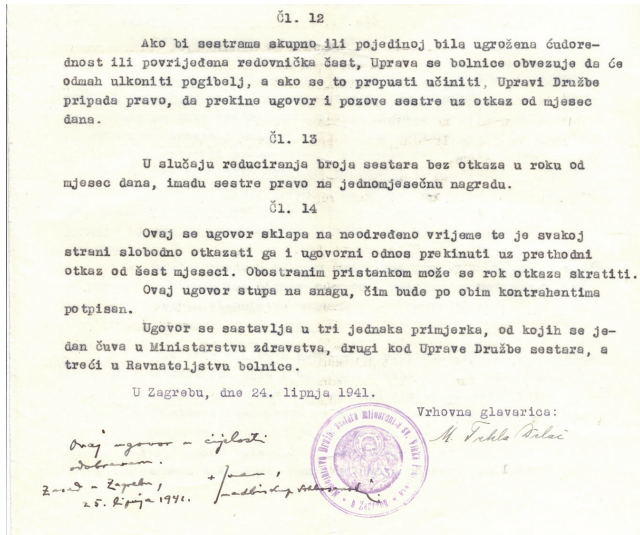


Figure 8 Part of the agreement accepted on 24 June 1941 – Archives of the Congregation.

III. Sarajevo bolnica 1919.				
Broj	Otkaz	Ime sestara predložnice	Dokada	Primjedba.
1.	od 13. 3. 1919.	s. Mirjana Badurjanić	do 30. 9. 1921.	Otkaz u Zagrebu
2.	" 1. 10. 1921.	s. Lavinija Stefančić	" 14. 7. 1927.	Otkaz u Splitu.
3.	" 23. 7. 1927.	s. Sabina Lovrenčić	" 9. 8. 1933.	" Zagreb
4.	" 9. 8. 1933.	s. Sebastijan Vidović	" 16. 8. 1939.	
5.	" 16. 8. 1939.	s. Melitina Marusić	" 14. 9. 1942.	
6.	" 14. 9. 1942.	s. Andriana Kleber	" 25. III. 1946.	
7.	" 28. III. 1946.	s. Demetrija Polcar	" 13. VII. 1949.	
(Dne 1. IX. 1949. ukinuta filijala.)				
8.	" 13. VII. 1949.	s. Lovrenca Margeljić	do 20. III. 1953.	
9.	" 20. III. 1953.	s. Ljiljana Bošnjaković	" 7. V. 1959.	
10.	" 7. V. 1959.	s. M. Primijica Ploz	" 5. I. 1966.	Š. broj. 5. I. 1962.

Sestre su se poselile u vlastiti novostan, "Stij" 1941
Filijala kod Sarajeva u. prosinca 1962. - bez danom filijala ukinuta.
Nasle i dalje u bolnici. Neki brojčani u str. 141 br. 337.

Figure 9 List of Superiors in Sarajevo – Archives of the Congregation.

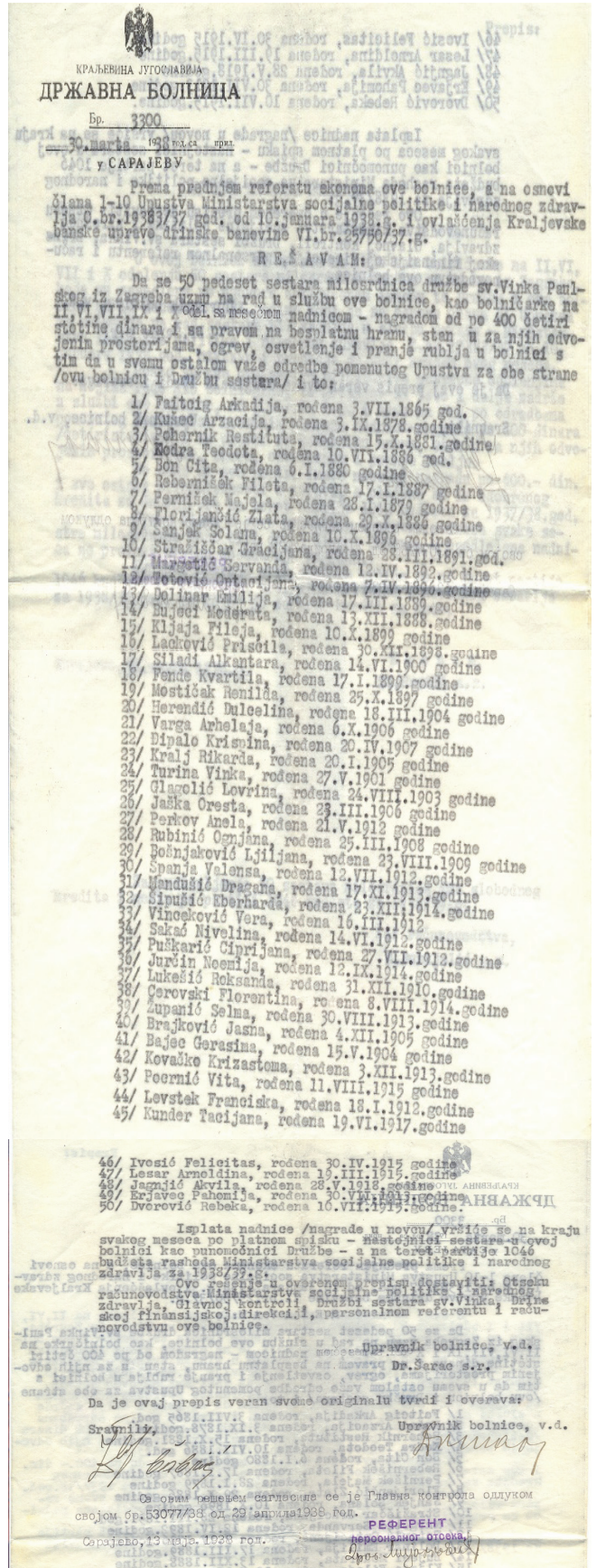


Figure 10 List of sisters admitted in 1938 – Archives of the Congregation.

During the World War II, the hospital administration sent requests for an increase in number of nurses, and the Supreme Administration tried to comply as much as possible. Thus, on 14 June 1941, the Administration requested 15 nurses, followed by the request for two more, which resulted in over 90 nurses working in the hospital, certainly the largest number of nurses in the institution (9).

According to an article in “Naš vjesnik” from 1941, the Director Dr Nikola Šeparović introduced the sisters to all the hospital pavilions, except to those where nuns were not allowed to work. Considering the large number of nuns, there was a need for a larger chapel which construction was approved by the hospital administration. The cornerstone was blessed on 14 September 1941 by the Archbishop of Vrhbosna, Dr Ivan Ev. Šarić, and the construction progressed quickly, thus creating a better environment for religious and hospital activities (9).

On 6 April 1945, Sarajevo was liberated from the Second World War occupiers, which resulted in a new hospital administration establishment. Already in August of the same year, in accordance with the new goals of the social system and educational reforms, the new hospital administration begin with the gradual dismissal of the nuns, starting with the oldest. Given their number and the need for gradual reorganization, on 20 September 1945, a new agreement was concluded between the leadership of the Congregation and the hospital administration (10).

Soon afterwards, the hospital administration started advising the sisters to replace their religious uniforms with civil ones in order to keep their jobs. The sisters were no longer recognized as a community under the Congregation management, but were given the status of other hospital employees and citizens. Since then, they have been treated as individual employees, with the same rights and obligations as all other employees (10).

The sisters did not make that decision on their own initiative. Aware of their religious vows, they approached the Congregation leadership. After an agreement with the church authorities, they were given permission to accept the new conditions and remain in service, although this meant wearing civilian clothes. Consequently, between 40 and 50 nurses remained in the hospital, each of them signing an individual employment contract (10).



Figure 12 Sisters in civilian clothes with priest Rev. Stjepan Ilić – Archives of the Congregation.

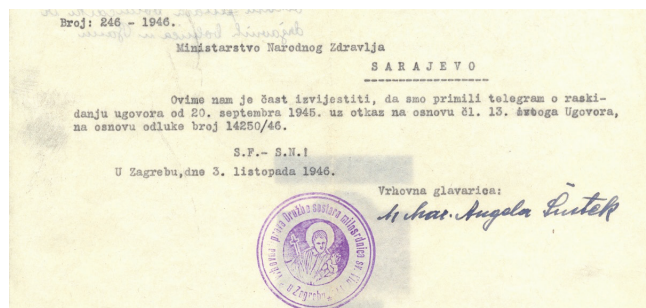


Figure 11 Notice of dismissal in 1946 – Archive of the Congregation.

These changes brought certain consequences: the chapel was closed, the hospital was left without a permanent priest, and instead of separate accommodation the sisters were placed into common ones. Despite the new circumstances, the sisters retained a sense of belonging to their community. Under the leadership of the prioress, they tried to nurture the spirit of St. Vinko - through love, sacrifice and prayer, nurturing “the living root of the cut tree” (1).

The nurses who remained working at the hospital eventually got apartments and enjoyed the same rights as other employees. Nevertheless, they lived permanently in hope and believed that these unnatural conditions for the religious community would end, and that they would gather again in the monastery and work in their religious robes.

That hope eventually materialized. The Daughters of Charity have continued their work in the Clinical Center University of Sarajevo up to now (6).

FRANCISCAN SCHOOL SISTERS

Province of the Franciscan School Sisters of the Holy Family - Mostar

The Franciscan School Sisters of Christ the King of the Holy Family from Mostar, better known as the Franciscan Sisters of the Herzegovina Province, initially worked in schools, as their name implied, and that was until the end of World War II. The year 1949 was very difficult for the sisters, as the new authorities seized their eleven schools in Herzegovina. In such circumstances, it was clear to them that they had to turn to other activities. It was necessary to continue to earn a living, adapting to the difficult wartime circumstances everybody had to deal with (11).

Already in 1951, four sisters came to Sarajevo to attend the hospital school, specifically: s. Kamila (Matija) Milas, s. Salesija (Matija) Anić, s. Petronila (Jagoda) Vasilj and s. Katarina Corluka. Until 1953, they were accommodated in a mixed student dormitory. -

After completing the hospital school, all four of them started working in the Clinical Center in 1953: Sr. Salezija (Matija) Anić worked at the General Internal Medicine Department until 1957, Sr. Kamila (Matija) Milas worked at the Gynecology Department until 1961, Sr. Petronila (Jagoda) Vasilj worked in a mental hospital until 1959, while the obituary does not contain any information about Sister Katarina Čorluka; it is possible that she left the religious community. These nurses worked at the Clinical Center as other nurses, without a habit, given the administration did not allow

that. However, they were accommodated in the hospital, which was very important for their life and work in the beginning. Only later, due to the small living space, did they have to request other accommodation, thus leaving their residence in the Clinical Center in 1958 (12).

A large number of nurses worked at the Clinical Center in Sarajevo leaving a notable impact. After completing hospital school in Niš, sister Leonija (Elizabeth) Kupek, worked at the Third Internal Clinic from 1956 to 1966. Sister Filomena (Anica) Dugandžić worked at the Skin Clinic from 1957 to 1974, where she nursed leprosy patients. Nurse Josipa (Željka) Šimić worked at the Infectious Diseases Clinic, initially from 1969 to 1971, and then again from 1973 until her retirement, where she also served as head nurse for a long time and in addition to her work she completed medical school in Belgrade. Sister Dobroslava (Matija) Vučić worked at the Third Internal Clinic from 1961 to 1971, continuing her work in Mostar, where she obtained a higher medical degree (13).

Sister Pija (Dana) Slišković started her working career in 1961 at the First Internal Clinic. Afterwards, she was the head nurse at the Sarajevo Health Center for ten years, and in addition to her work, she also graduated from the Higher Medical School in Belgrade (14). Nurse Borislava (Ana) Martinović worked in the Abdominal Surgery Department since 1962 and since 1973 in the Maxillofacial Clinic as the head nurse of the Intensive Care. After 1993, she continued working in Mostar and then at the Merkur Hospital in Zagreb, where she remained until her retirement in 2001 (15).

Sister Goretti (Mira) Kozarić worked from 1971 to 1993, initially at the Infectious Diseases Clinic followed by Orthopedic Clinic. She graduated from the Higher Medical School in Sarajevo, and her life was tragically ended in the war. Sister Boneventura (Iva) Paradžik, after working career in Italy, came to Sarajevo in 1972 and was employed at the "Podhrastovi" Lung Disease Clinic, where she remained until her retirement in 1994. Nurse Silvija (Dinka) Galić worked in Abdominal Surgery Clinic since 1974, where she was the head nurse of the Intensive Care for a longtime. Due to the

war in 1994, she went to Mostar and continued her working career at Orthopedic Clinic until 2008. She graduated from the Sarajevo Medical School. Sister Jelenka Puljić started her working career in 1974 at the Maxillofacial Surgery Clinic in Sarajevo, where she remained until 1993. At the same time she studied pedagogy and psychology at the Faculty of Philosophy in Sarajevo. Since 1986, Sister Marija Bešker worked at the Traumatology Clinic and Institute for Vascular Diseases, and from 1992 again at Traumatology, where she remained until her retirement in 2021. For most of her working career, she was the head nurse of the Intensive Care and Traumatology Department. She graduated from the Sarajevo Medical School.

Since 2002, Sister Samuela (Kata) Bešker worked at the Department of Child and Adolescent Psychiatry of the Psychiatry Clinic, where she was the head nurse since 2014. She graduated from the Faculty of Health Studies in Sarajevo, obtained training in tropical diseases in Belgium and a master's degree in pedagogy at the Faculty of Philosophy (16).

The Sisters of Christ the King and the Bosnian-Croatian province of the Immaculate Heart of Mary in Sarajevo

After the Second World War, the sisters of this Province were deprived of the schools and kindergartens they had been working in, so they had to seek new job opportunities. An opportunity for their engagement appeared in the Sarajevo hospital, and in 1973, eight nurses were employed at a new Dental Clinic. Some of them pursued their careers as nurses, while others were employed as cooks and waitresses.

Among the sisters who dedicated their lives to work at the Clinical Center was Dolorosa (Ruža) Dilber, who in 1962 in Germany graduated from the Higher Special Education School for working with children with visual impairments obtaining the title of Orthopist. From 1974, she worked at the Eye Clinic in Sarajevo, where she remained until her retirement in 1989. Justina Tomić started her working career as a nurse at the Dental Clinic in 1973, continuing it at the Maxillofacial Clinic until the beginning of the Homeland War, when she departed to Croatia. Ružica Oršolić

worked for a short time at the Eye Clinic in Sarajevo from 1989, after graduating in 1988 from the Belgrade Higher School for the Education of Personnel in the Field of Pleoptics and Orthoptics. She didn't stay long because she didn't get the job she was trained for, so she continued working in Zagreb. Zvezdana Knežević worked at the Neurology Clinic from 2001 to 2002, when she departed to Germany to be a health visitor.

In addition to pursuing their working careers as nurses, a large number of nuns worked as cooks and waitresses at the Dental, Maxillofacial Clinic, and the Institute for Physiotherapy and Rehabilitation in Ilidža (16).

ADORATION OF THE BLOOD OF CHRIST

The providential beginning of the Adorers of the Blood of Christ in Sarajevo dates back to 1971, with the arrival of Sr. Slavka Matijanić, one of the most prominent Adorers, and later Sr. Marcijana Krištić.

Sister Marcijana Krištić graduated from the Secondary Medical School in the Sarajevo neighborhood of Bjelave and the Higher Medical School in Sarajevo. She worked in the C3 Intensive Care Unit of the Clinical Center, followed by Maxillofacial Surgery Department (intensive care until 1990, and in operating theater until 1998). From 1998, she was the head nurse of the Diagnostic and Polyclinic (DIP), and from 2007, the head nurse of the Maxillofacial Clinic (MFC) until her retirement in 2015. Sister Katarina Stojanović (Celestina) came to Sarajevo in 1972. She started her working career at the C3 Intensive Care Department of the Clinical Center, followed by Second Internal Medicine Clinic. While working, she graduated from the Sarajevo Higher Medical School (17).

The Adorers of the Blood of Christ moved into a house at Koševsko Brdo on 3 September 1988, being active in their work with the sick, catechization, and the parish choir running. Nowadays, three sisters live in the house: one looks after the female students, the other works in the Secretariat of the Bishops' Conference of Bosnia and Herzegovina, and the third is a Secretary of the Conference of Senior Religious

Superiors of Bosnia and Herzegovina. The chapel of the Blood of Christ is located in the monastery (17).

THE CONGREGATION OF SISTERS OF THE SERVANTS OF THE LITTLE JESUS

The Congregation of Sisters of the Servants of Little Jesus was founded in 1890 in Sarajevo by the first Archbishop of Vrhbosna, Dr Josip Stadler.

Sister Servant of the Little Jesus Dragica Adžamić, religious name Sister Krunoslav, graduated from the health school, majoring in nursing, in the Sarajevo settlement of Bjelave, in the period from 1970 to 1974. From April 1976 to December 1977, she worked at the Department of Neurosurgery of the Clinical Hospital Dr Blagoje Kovačević in Sarajevo (18).

CONCLUSION

Today (September 2025) there are 4 nuns - nurses working at the Clinical Center University of Sarajevo, 3 from the Congregation of the Sisters of Charity of St. Vincent de Paul: Sr. Margareta /Slava/ Brnada, (Clinic of Gastroenterohepatology), Draženka /Rahela/ Brkić (Clinic of Orthopedics and Traumatology), Sr. Marija /Antonija/ Hrgota (Clinical Biochemistry and Laboratory Medicine) and one Franciscan School Nurse of Christ King Samuela /Kata/ Bešker (Psychiatric Clinic, Department of Child and Adolescent Psychiatry). There is a great desire and hope that the number of nuns - nurses at the Clinical Center University of Sarajevo will increase in the future.

REFERENCES

- Vračić B, Kovačić A. Sestre milosrdnice sv. Vinka Paulskoga s kućnom maticom u Zagebu: 1845-1995. Zagreb: Družba sestara milosrdnica sv. Vinka Paulskoga, 1996. (Posebna izdanja; knj.2) ISBN 953-96820-0-2
- Pfanner AW. Arhiv Družbe sestara milosrdnica u Zagrebu: (1845-1862). Zagreb: Družba sestara milosrdnica sv. Vinka Paulskoga; s.a.
- <https://www.redovnistvo.ba/hr/page.php>
- <https://www.klanjateljice.hr/nase-zajednice/>
- <https://ssmi.hr/kontakt-informacije/hrvatska/sarajevska-provincija>
- Sto dvadeset godina Zemaljske bolnice 120 godina Zemaljske bolnice u Sarajevu :1894.-2014. / [urednik Zoran Hadžiahmetović]. – Sarajevo: Institut za naučnoistraživački rad i razvoj, UKCS, 2014.:303 str.:ilustr. ISBN 978-9958-00-005-8
- ADSM.br.13/1919;Povijest družbe, str.428.
- ADSM,br.722/1931;ADSM,Sarajevo,državna bolnica – Kronika, str.2.5.Dokumentacija,toč.10
- Mašić I. Korijeni medicine i zdravstva u Bosni i Hercegovini. Sarajevo: Avicena; 2003: str. 88-154.
- ADSM. br.201/1945. Ugovor o uzimanju sestara milosrdnica za njegu bolesnika u bolnicama-Ministarstvo narodnog zdravlja Vlade BiH.
- Palac BN. Školske sestre Trećega reda Sv. Franje u Hercegovini. Mostar: Provincijalat Školskih sestara; 1975: str. 87.
- Kronika Školske sestre sv. Obitelji Sarajevo godine; 1951., 1953., 1961., 1973., 1974., 1975., 1986., 2002.g.
- Palac NS. U knjigu života upisane. Mostar; Provincijalat Školskih sestara franjevačka Provincije Svete obitelji; 2013.
- Intervju sa sestrom Pijom (Danom) Slišković, zagarovala sestra Samuela Kata Bešker 19.07.2025.g. u Širokom Brijegu (ovo ne može ako nije objavljeno kao i ova ispod)
- Intervju sa sestrom Borislavm (Anom) Martinović, telefonski razgovor vodila sestra Samuela Kata Bešker 29.07.2025.g (Sarajevo-Zagreb).
- Nekrologij. Mostar: Školske sestre franjevačke Krista Kralja, Provincija Svete Obitelji; s.a.
- <https://www.klanjateljice.hr/nase-zajednice/sarajevo-samostan-krvi-kristove/>
- <https://ssmi.hr/sarajevo/>

Authors' Contributions: S. M(S)B, MČ, S. S(K)B, SDŽ, SZ and TK contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Financial Support and Sponsorship: nil.

Conflict of Interest: there are no conflicts of interest.

The Impact of Workload on the Quality of Life of Medical Workers in the Intensive Care Unit

Uticaj radnog opterećenja na kvalitetu života medicinskih radnika na odjelu intenzivne njege

Majda Gazap^{1*}, Amer Ovčina², Mirsada Čustović², Senada Džebo³, Anela Džananović⁴

¹ Clinic of Cardiovascular Surgery, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

² Department for Quality and Safety of Healthcare Services, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

³ Head Nurse, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

⁴ Faculty of Management and Business Economics, University of Travnik, Azapovići 439, 71259 Kiseljak, Bosnia and Herzegovina

***Corresponding author:** Majda Gazap, Clinic of Cardiovascular Surgery, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina, Email: gazapmajda@gmail.com

ABSTRACT

Introduction: the research investigates the impact of Quality of Work Life (QWL) on the professional performance of healthcare workers, with the aim of improving their working conditions and overall efficiency in the healthcare sector.

Aim: to analyse how various factors that contribute to Quality of Work Life influence the motivation and professional efficiency of employees in healthcare institutions.

Materials and methods: the study focuses on identifying key aspects of QWL, such as work atmosphere, job organization, and emotional support, and linking these factors to job satisfaction and the quality of healthcare services provided.

Results: the results show that improving working conditions, reducing stress, and strengthening interpersonal relationships within the team directly contribute to increased employee satisfaction and efficiency.

Conclusion: continuous investment in improving the Quality of Work Life for healthcare workers is essential to enhance their motivation, reduce stress, and ultimately improve the quality of services they provide to patients.

Keywords: nurses, quality of life, work environment, workload, intensive care unit.

SAŽETAK

Uvod: Kvalitet života zdravstvenih radnika zaposlenih u jedinicama intenzivnog liječenja povezan je sa zadovoljstvom poslom, radnim okruženjem, generičkim poslovnim strategijama orijentiranim na dugoročno održivo zdravlje zaposlenih.

Cilj: analizirati kako različiti faktori koji čine kvalitet radnog života utiču na motivaciju i profesionalnu efikasnost zaposlenih u jedinicama intenzivne njege – terapije.

Metrijali i metode: istraživanje se fokusira na identifikaciju ključnih aspekata QWL-a, kao što su radna atmosfera, organizacija posla, i emocionalna podrška, te njihovo povezivanje sa zadovoljstvom na radnom mestu i kvalitetom pružene zdravstvene usluge.

Rezultati: rezultati pokazuju da poboljšanje radnih uslova, smanjenje stresa i jačanje međuljudskih odnosa u timu direktno utiču na povećanje zadovoljstva i efikasnosti zaposlenih.

Zaključak: potrebno je kontinuirano ulagati u poboljšanje kvaliteta radnog života zdravstvenih radnika kako bi se povećala njihova motivacija, smanjio stres, i na kraju poboljšala kvalitet usluga koje pružaju pacijentima.

Ključne riječi: medicinske sestre, kvalitet života, radno okruženje, opterećenost, intenzivna jedinica.

INTRODUCTION

The objective of the health system is to ensure the physical, mental and social health of people, while at the same time creating an environment in which health workers can provide better quality and more efficient service (1).

The quality of work life also includes the ability of employees to satisfy their personal needs through work in the organization, which increases productivity in the long term. The quality of working life in the organization is shaped by a fair, equal and encouraging attitude towards employees, as well as the ability of all employees to make the most of their abilities and achieve the highest level of self-realization (2,3).

Nurses spend a large part of their lives in the work environment, so quality of work life and organizational commitment are two key components for health personnel. Dissatisfaction with these issues has an impact on their other roles at home and in the community, as it reduces their emotional and physical capacity to perform everyday tasks (4).

In addition, dissatisfaction in the workplace can lead to stress, burnout and reduced productivity, which negatively affects the quality of care provided to patients. Therefore, it is important to create a work environment that supports the well-being of healthcare workers, so that they can better serve patients and contribute to the overall health of society (5).

The nurse's workload is divided into two parts:

- 1) Direct care, which is an activity that emphasizes the direct interaction between nurses providing care with patients and their families as recipients of nursing care;
- 2) Indirect care, focused on complementary activities such as documentation, arranging interventions and carrying out cooperation additional tasks, which include administrative engagements, home visits and other activities not related to medical care (5,6,7).

Contemporary literature supports the conclusion that the number of nurses and their workload influence nurse satisfaction, staff turnover, and patient outcomes. Other factors related to patient safety include the association of fewer years of experience in the clinical unit with higher patient mortality and increased incidence of infections (7,8).

High workload has been shown to be associated with suboptimal patient care and nurse burnout. Staffing variables constitute an important aspect of the nursing practice environment that affects not only outcomes for patients, but also for nurses and organizations (9,10).

Nurses perform professional knowledge at their work, but also personal experiences. Sometimes they identify with patients because of similar life situations that they have gone through. One of the challenges they face is the ability to separate their patients' experiences from their own, which often seem very similar. Although nurses are trained to keep an emotional distance from their work, sometimes they unconsciously react to the emotions experienced by their patients and their families (11).

The impact of workload on the quality of life of medical workers in the intensive care unit is a very significant factor that affects the physical, mental and emotional health of employees. Working in an intensive care unit entails extremely high stress conditions, where medical workers face difficult and urgent situations, which can have serious consequences for their professional and personal well-being (12).

Factors that affect satisfaction with the work environment and have repercussions on the overall quality of life are the following: salaries and personal income, technological and organizational working conditions, working conditions that affect well-being, safety needs, information about events within the organization and business strategies, mutual relations, internal communication system, recognition and rewards, interestingness and creativity of work, job demands, responsibility at work, freedom and independence, possibility of individual participation, opportunities for learning and development and professional training and progress. (13,14,15,16).

AIM

The aim of this paper was to analyse the level of workload among medical workers in the intensive care unit; to examine how workload affects the physical and mental health of medical workers; to investigate the impact of workload on the quality of life of medical workers; to examine the relationship between workload and job satisfaction and to recommend strategies for reducing workload and improving the quality of life of medical workers.

MATERIALS AND METHODS

Respondents

The research included a total of 112 medical workers (doctors and nurses-technicians) employed in intensive care units in the Federation of Bosnia and Herzegovina hospitals. Employees of the Clinical Center University of Sarajevo, Cantonal Hospital “Dr. Safet

Mujić” Mostar, County Hospital “Fr. Mihovil Sučić” Livno, and Travnik Hospital voluntarily participated in the research.

Methods

The research was quantitative, descriptive, cross-sectional, and comparative. The research instrument was a standardized questionnaire taken from the scientific publication “Instruments for Scientific Research in the Field of Health and Health Management” (University Textbook - University of Sarajevo, Faculty of Health Studies Sarajevo, by Ovcina A, et al.). The questionnaire was adapted in certain segments of the research area and the group of respondents. It contained both open and closed questions, and was created in the electronic application “Google Forms”.

The questionnaire was available to respondents via email. It was anonymous, and the answers did not allow for the respondents identification. The scientific methods used in this research included induction, deduction, synthesis, compilation and concretization. The research was conducted in the period from 3 September to 1 November 2024.

RESULTS

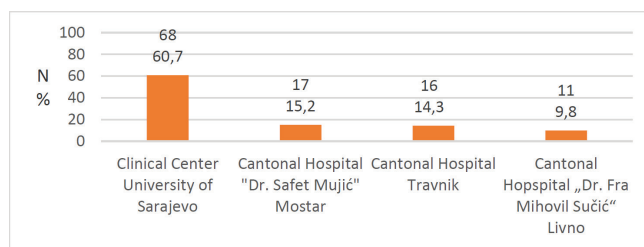


Figure 1 Basic set of respondents.

The largest number of respondents who participated in this research was from the Clinical Center University of Sarajevo, specifically 68 (60.7%).

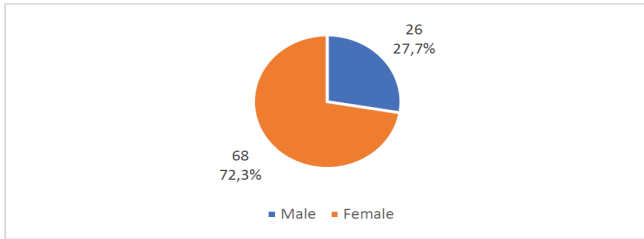


Figure 2 Gender of the respondents.

Analysis of the gender structure indicated that women were more represented in the sample in 68 or 72.3% of cases, compared to 26 or 27.7% of men.

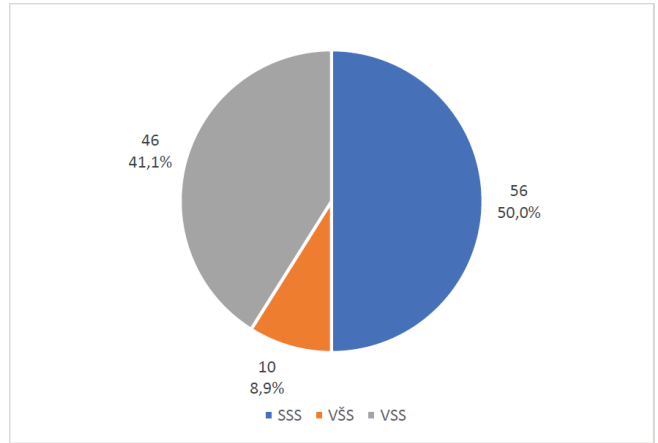


Figure 5 Professional qualifications of the respondents.

An overview of the respondents’ professional qualifications showed that exactly half of the respondents, 56 or 50.0%, had secondary school education, 46 or 41.1% high school, and the smallest number of respondents was with university degree, 10 or 8.9% of them.

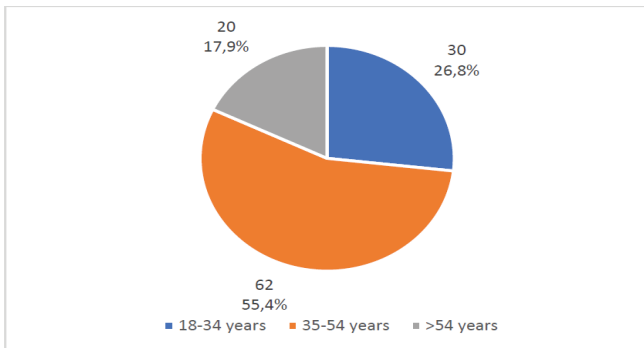


Figure 3 The age of the respondents.

The analysis of the age structure indicated that the largest number of respondents was in the age group of 35-45 years (62 or 55.4%), followed by respondents aged 18-34 (30 or 26.8%), and the smallest number of respondents was in the oldest age group, specifically in the over 54 (20 or 17.9%) age group.

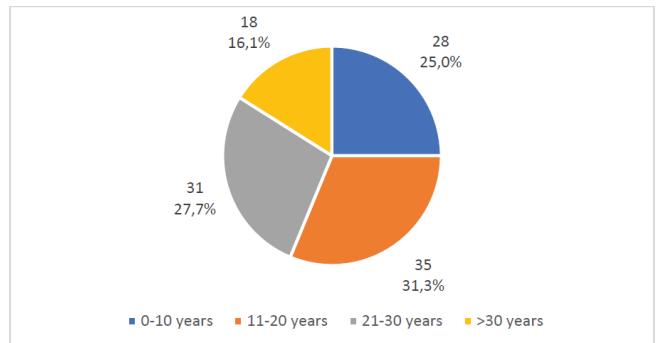


Figure 6 Work experience of the respondents.

According to the length of service of the respondents, the largest number had 11-20 years (35 or 31.3%) work experience, followed by those with 21-30 (31 or 27.7%), and 0-10 years (28 or 25.0%).of work experience Out of the total number of respondents, 18 or 16.1% of them had over 30 years of work experience.

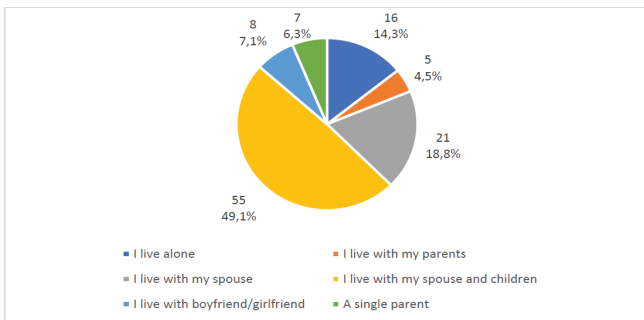


Figure 4 Marital status.

The largest number of respondents lived with their spouse and children, 55 or 49.1%, and 21 or 18.8% only with their spouse. The smallest number of respondents lived with their parents, 5 or 4.5% of them.

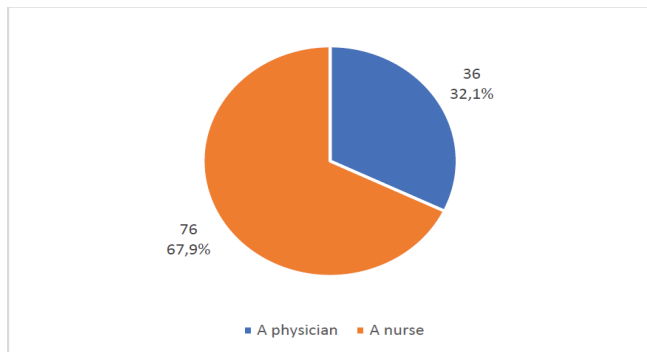


Figure 7 Occupation of the respondents.

The survey included a total of 36 or 32.1% of physicians, and 76 or 67.9% of nurses.

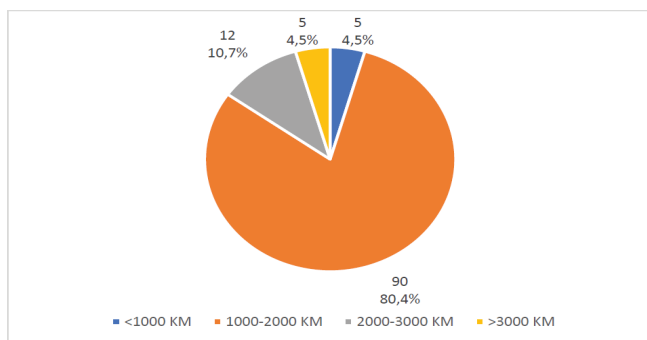


Figure 8 Monthly income of the respondents.

The largest number of respondents, 90 or 80.4%, reported having a monthly income between BAM 1,000 and 2,000, followed by respondents with the income in the amount of BAM 200-3,000 (12 or 10.7%), and in 5 or 4.5% of cases, respondents reported having a monthly income under BAM 1,000 or above 3,000.

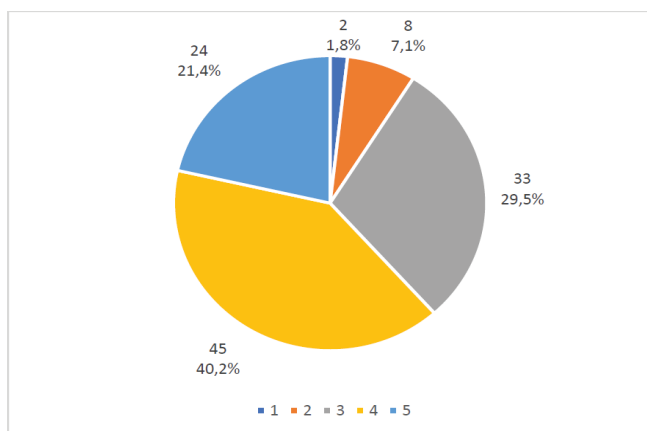


Figure 9 Health conditions of the respondents.

Respondents rated their health with an average score of 3.7 ± 0.94 .

Most often, respondents rated their current health with a score of 4 (45 or 40.2%), followed by score of 3 (33 or 29.5%), and with a score of 5 in 24 or 21.4% of cases.

Out of the total number, 8 or 7.1% of respondents rated their health as 2, and only 2 or 1.8% of respondents rated it as 1.

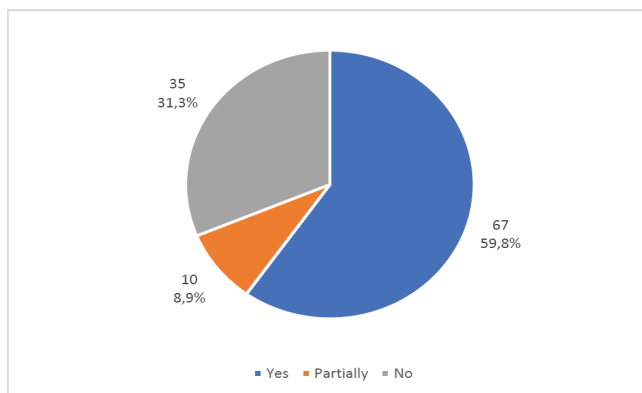


Figure 10 Satisfaction with the respondents' workplace.

An overview of respondents' job satisfaction showed that the majority of them (67 or 59.8%) were completely satisfied with their job, 10 or 8.9% were partially satisfied, and 35 or 31.3% of the respondents were not satisfied.

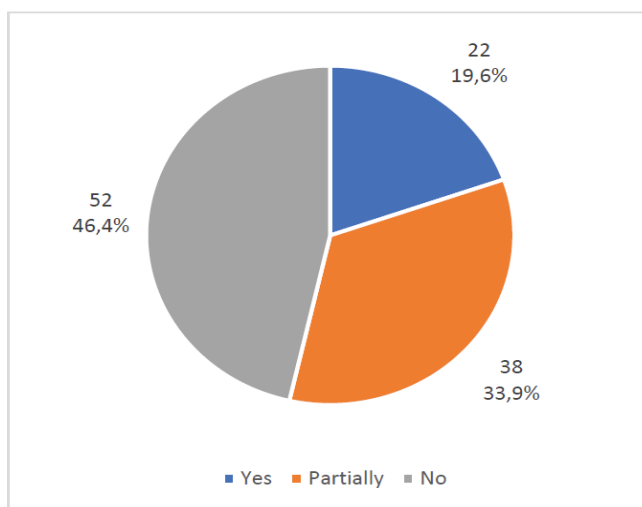


Figure 11 Satisfaction with respect in the workplace.

An overview of the respondents' satisfaction with workplace evaluation showed that the largest number of respondents was dissatisfied (52 or 46.4%), 38 or 33.9% of respondents were partially satisfied, while 22 or 19.6% of respondents were completely satisfied with the workplace evaluation.

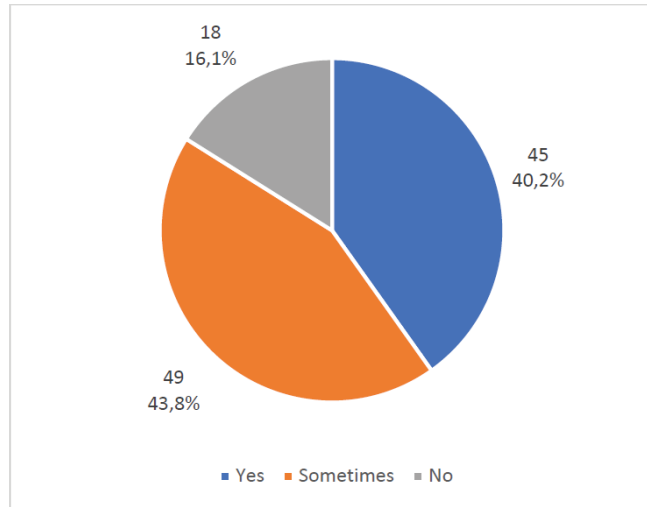


Figure 12 Availability to the family.

Most respondents lacked time for their family, 45 or 40.2% completely and 49 or 43.8% of them partially. Only 18 or 16.1% of respondents stated that they had not lacked time for their family.

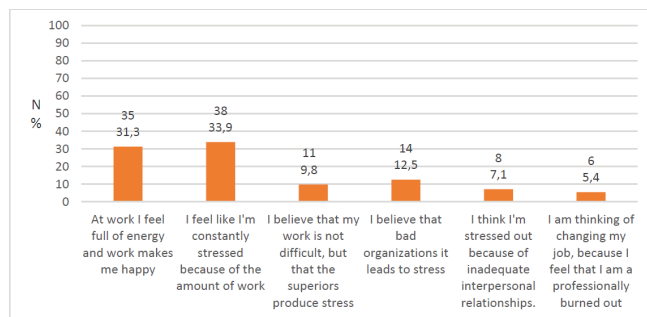


Figure 13 Review of respondents' feelings towards work.

Respondents mainly stated that they had felt constantly stressed at work due to the workload (38 or 33.9%), but also 35 or 31.3% of them stated that they had felt drained of energy at work and that their job made them unhappy.

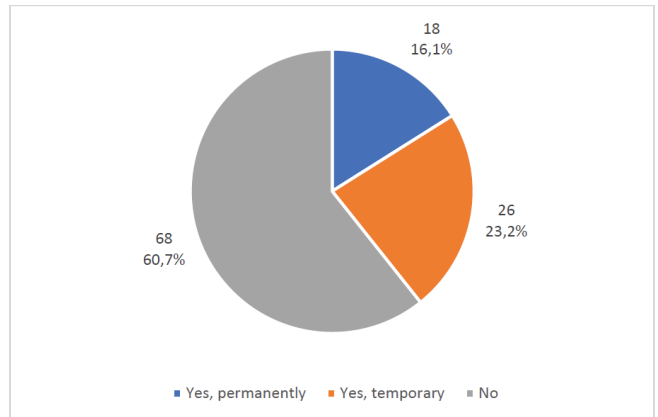


Figure 14 Overview of the representation of the desire to change the workplace.

The majority of respondents, 68 or 60.7% of them, did not have any desire to change their jobs. Out of the total number, 18 or 16.1% of the respondents wished to change their jobs permanently, while 26 or 23.2% of them would occasionally regret changing their jobs.

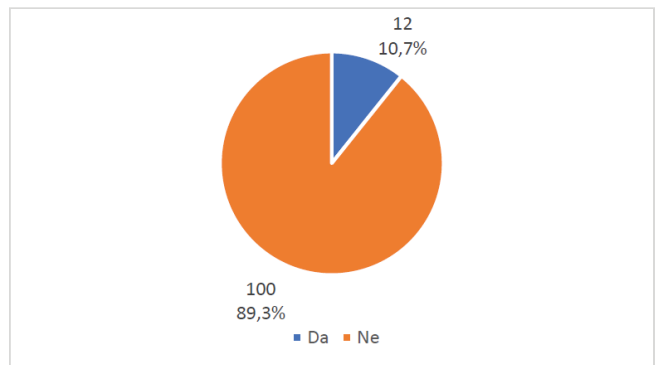


Figure 15 Review of absences from work due to conditions caused by increased workload.

An overview of the prevalence of work absence - sick leave in the past 6 months caused by increased workload showed that 12 or 10.7% of them experienced such absences.

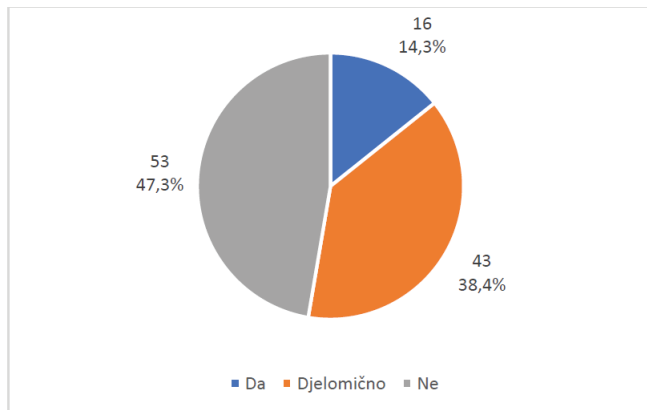


Figure 16 Overview of the prevalence of making mistakes due to workload.

In 52.7% of cases the respondents stated that they had made mistakes when overloaded with work, 16 or 14.3% of respondents always did so, and 43 or 38.4% of respondents did it partially. Out of the total number, 53 or 47.3% of respondents stated that they had not made mistakes when overloaded with work.

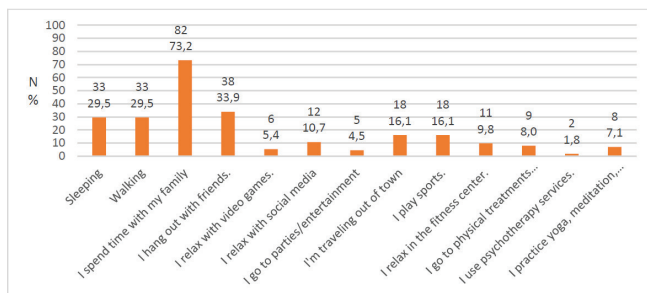


Figure 17 An overview of ways to relax after work.

The most common ways of relaxing after work was “Spending time with the family” in 82 or 73.2% of cases, followed by “Hanging out with friends” in 38 or 33.9% of cases.

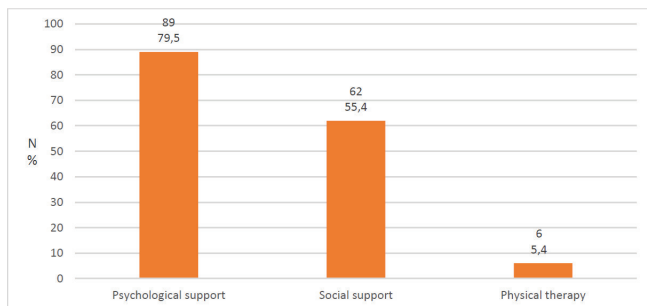


Figure 18 Overview of employees’ help service availability.

Among the assistance services for employees, psychological assistance was most frequently provided in 89 or 79.5% of cases, as well as social assistance in 62 or 55.4% of cases. Physical therapy was available in only 6 or 5.4% of cases, while other forms of assistance were not mentioned by the respondents.

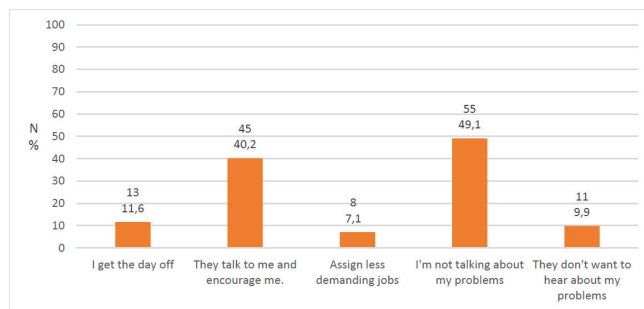


Figure 19 Overview of ways to help superiors in case of problems in the work process.

DISCUSSION

Based on the results of the research, several significant patterns and trends could be observed in the demographic, social and professional characteristics of the respondents, as well as their attitudes towards work and engagement in the health care process.

The largest number of respondents was with working experience of 11-20 years, which indicated professional experience. This data also suggested that the respondents had already formed their professional identity and approach to health care. Cumulative work experience of 21-30 years represented the next largest segment, while a smaller number of respondents could boast with long-term experience (over 30 years). Given the relatively high percentage of nurses, it could be assumed that those professors, given their length of service, were particularly engaged in the implementation of health care.

Almost all respondents worked 40 hours or more per week, which was typical for medical professions, especially in hospitals and large healthcare facilities. Regarding engagement in the healthcare process, the vast majority of respondents rated their engagement

as high, suggesting that healthcare professions were, at least according to respondents' own perceptions, characterized by high motivation and commitment.

Although the majority of respondents (59.8%) reported being satisfied with their jobs, almost one third (31.3%) were not satisfied, which might indicate existing problems in work organization, conditions, or satisfaction with salaries. That indicated the need for further research into the causes of dissatisfaction and finding solutions that could increase motivation and reduce employee turnover in healthcare facilities.

A total of 40.2% of the respondents felt that they lacked time for the family, while 43.8% stated that they occasionally missed the family. This could be related to work overload.

Respondents most often rated their health as 4 (40.2%) or 3 (29.5%), and the condition of their families with similar ratings. Although the majority felt relatively healthy, it should be noted that there was also a smaller percentage (7.1%) who rated their health as poor.

Out of the total number of respondents, 11.6% of them had occupational diseases, and 75.9% did not perform health examinations, which could cause concern in the context of prevention and health preservation.

Almost half of the respondents, 33.9% of them, stated that they had been under constant stress due to the amount of work, while 31.3% stated that they felt energetic and happy because of their work. This pointed to significant differences in employees' experience, with some enjoying their jobs while others experience stress.

A part of the respondents, 14.3% of them, admitted that they had made mistakes when overloaded with work, and 38.4% admitted that they partially made mistakes, which could have a serious impact on the quality of work.

The largest number of respondents, 84.8%, believed that they were burdened with administrative

tasks, which might suggest too many administrative tasks burdening daily work, thus reducing the time for direct work with patients or clients.

More than half of the respondents (65.2%) believed that they worked too much during the day, and 28.6% state that they occasionally worked too much, which might indicate a high level of work exhaustion.

The largest number of respondents (73.2%) spent time with their family after work, which suggested that it was a key activity for relaxation and emotional support. Also, many respondents were engaged in physical activities such as walking (29.5%) or sports (16.1%), which could contribute to reducing stress and improving health.

When working with patients, the majority of respondents (66.1%) stated that they had tried to complete all tasks, while 58% of respondents expressed compassion and did their best to help patients. However, there were also some negative indicators such as 14.3% of respondents who just wanted the shift to end, which might indicate fatigue or professional burnout.

Previous researches

One of the similar researches was conducted in Croatia and was published in the "Health Care" magazine under the title "Professional quality of life of nurses/technicians". The aim of this research was to examine and describe the professional quality of life of nurses and technicians in Croatia. The research included 229 nurses and technicians employed at all levels of health care. Data were collected through a questionnaire covering various aspects of professional quality of life, including stress, job satisfaction and balance between private and professional life. The results showed that nurses and technicians were faced with high levels of stress and challenges in maintaining a balance between private and professional life (17).

The second research, under the title "Assessment of the workload of nurses in the intensive care unit",

was published in "Liječnički vjesnik". The aim of this research was to assess the workload of nurses in intensive care units. The research was conducted in several hospitals in Croatia, and data were collected through a questionnaire covering various aspects of workload, including the number of patients, the complexity of medical procedures and working conditions. The results showed that nurses in intensive care units faced a high workload, which could affect the quality of the health care provided and the professional quality of life (18).

The third study, entitled "Burnout syndrome of nurses in intensive care units", was published in the "Medicina fluminensis" Journal. The aim of this study was to examine the prevalence of burnout syndrome among nurses in intensive care units. The research was conducted in several hospitals in Croatia, and the data were collected through a questionnaire covering various aspects of burnout syndrome, including emotional exhaustion, depersonalization and reduction of personal achievements. The results showed that the prevalence of burnout syndrome among nurses in intensive care units was high, which could negatively affect quality of life and professional quality of life (19).

The fourth research, untitled "Management of professional stress in health care managers", was published in the Clinical Center University of Sarajevo Medical Journal. The aim of this research was to examine the level of professional stress among health care managers in different health care institutions. The research was conducted in several hospitals in Bosnia and Herzegovina, and data were collected through a questionnaire covering various aspects of professional stress, including emotional exhaustion, challenges in decision-making, balancing work and private life, and the impact of organizational support. The results showed that the level of professional stress among health care managers was significant, which negatively affected their efficiency in leading teams, quality of work and overall job satisfaction. Stress also had long-term negative consequences on the physical and mental health of managers, which could result in a decrease in the quality of services provided by health institutions (20).

CONCLUSIONS

High workload and stress

The analysis shows that the majority of employees in intensive care units experience a high workload, which is reflected in their answers about how they spend their vacations and perform work tasks. All these factors indicate a high level of stress, which can lead to professional burnout, reduced quality of life and health problems.

Lack of time for relaxation and family

The results show that the majority of respondents do not use their vacation in the best possible way. Also, although most employees spend time with their families after work, the fact that many do not rest at work and do not devote enough time to themselves indicate the need for better balancing of professional and private life.

Lack of support systems in the work environment

Although psychological and social support is often available, the number of employees who do not approach their superiors with their problems indicates existing barriers to communication and trust. The lack of physical therapy and other support services greatly reduces the effectiveness of existing support.

Emotional and physical health of employees

Older employees and those with longer tenure report poorer health, suggesting that long-term exposure to high stress can negatively impact their physical and mental health. Also, their social isolation and the impact on relationships with family and friends increase the risk of burnout and depression.

RECOMMENDATIONS

Introduce better time and rest arrangements

It is recommended to implement clearer guidelines

and rest times so that healthcare workers have enough time to relax during the workday. The work environment should support mental relaxation strategies, such as short meditation sessions, breathing exercises, or other stress-reducing techniques.

Improve communication with superiors

Employees should be encouraged to communicate with their superiors about issues that affect their effectiveness at work. Training managers on emotional intelligence, active listening, and employee support can improve interpersonal relationships in the team and reduce stress among employees.

Expanding employee support services

Employers should consider introducing additional forms of support, such as physical therapy, stress management training, and periodic health and social check-ups. Also, increasing access to different forms of support, such as psychotherapy or group therapy services, could have long-term benefits for employees' mental health.

Focus on professional development and health

Training to prevent professional burnout, as well as education on physical and mental resilience, can be useful tools to reduce stress in the workplace. Staff should be supported in developing skills to balance their professional and private obligations.

Support for older employees

Given the association between age and poorer health, specific strategies should be implemented for older employees, including lighter shifts, flexible working hours, and more support in preventing physical stress, as well as access to alternative methods of treatment and therapy.

Introduction of flexible shifts and rotations

Working in intensive care units can be very demanding. Flexible shifts and rotations can reduce

fatigue and stress among employees. Also, allowing more time for recovery and quality rest between shifts could positively affect the efficiency and quality of healthcare provided (11,21).

REFERENCES

1. Hashempour R, Hosseinpour Ghahremanlou H, Etemadi S, Poursadeghiyan M. The relationship between quality of work life and organizational commitment of Iranian emergency nurses. *Health Emerg Disasters Q.* 2018;4(1):49-54. doi:10.32598/hdq.4.1.49.
1. Kurtić A. *Poslovna organizacija*. Tuzla: Off-Set; 2005.
2. Bahtijarević-Šiber F. *Strateški menadžment ljudskih potencijala*. Zagreb: Školska knjiga; 2014.
3. Brooks BA, Anderson MA. Defining quality of nursing work life. *Nurs Econ.* 2005;23(6):319-26, 279. PMID: 16459904
4. Bajraktarević J. *Stres menadžment*. Sarajevo: Avery d.o.o.; 2014.
5. Pavičević L, Bobić J. Stres na radu. In: Šarić M, Žuškin E, editors. *Medicina rada i okoliša*. Zagreb: Medicinska naklada; 2001.
6. Nanjundeswaraswamy TS, Swamy DR. A literature review on Quality of work life and Leadership styles. *Int J Eng Res Appl.* 2012; 2(3):1053-9. ISSN: 2248-9622.
7. Jayakumar A, Kalaiselvi K. Quality of work life - an overview. *International Journal of Marketing, Financial Services & Management Research.* 2012; 1:140-51.
8. Jayaraman S, Chandran C. Quality of Work Life: A Stance from Nursing Professionals. *Inter Jour Nurs Educ.* 2010;2(1):15-21.
9. Vuletić G, Benjak T, Brajković L, Brkljačić T, Davern M, Golubić R, et al. *Kvaliteta života i zdravlje*. Osijek: Hrvatska zaklada za znanost; 2011
10. Dujić I, Gregov Lj, Slišković A. *Povezanost smjenskoga rada s društvenim i obiteljskim životom*

- radnika. *Med Jad.* 2014;44(1-2):13-25.
11. Caruso CC, Lusk SL, Gillespie B. Relationship of work schedules to gastrointestinal diagnoses, symptoms, and medication use in auto factory workers. *Am J Ind Med.* 2004;46(6):586-98. doi: 10.1002/ajim.20099.
 12. Švrakić S. Značaj permanentne edukacije medicinskih sestara s ciljem prevladavanja stresnih situacija u radu: doktorska disertacija. Mostar: Univerzitet „Džemal Bijedić“; ۲۰۱۳.
 13. Bahari G, Asiri K, Nouh N, Alqahtani N. Professional Quality of Life Among Nurses: Compassion Satisfaction, Burnout, and Secondary Traumatic Stress: A Multisite Study. *AGE Open Nurs.* 2022;8:23779608221112329. doi: 10.1177/23779608221112329.
 14. Sacco TL, Copel LC. Compassion satisfaction: A concept analysis in nursing. *Nurs Forum.* 2018;53(1):76-83. doi: 10.1111/nuf.12213.
 15. Zhang YY, Zhang C, Han XR, Li W, Wang YL. Determinants of compassion satisfaction, compassion fatigue, and burnout in nursing: A correlative meta-analysis. *Medicine (Baltimore).* 2018; 97(26):e11086. doi:10.1097/MD.00000000000011086.
 16. Valentina P. Profesionalna kvaliteta života medicinske sestre/tehničara. Diplomski rad. Rijeka: Sveučilište u Rijeci, Fakultet zdravstvenih studija u Rijeci; 2023.
 17. Vuković Lj. Procjena radnog opterećenja medicinskih sestara u jedinici intenzivne medicine primjenom bodovnih sustava. Diplomski rad. *Croatian Nursing Journal.* 2020;4(1):59-71. doi.org/10.24141/2/4/1/5.
 18. Šmaguc I. Sindrom izgaranja medicinskih sestara u jedinicama intenzivnog liječenja u KBC Zagreb. Diplomski rad. Zagreb: Sveučilište u Zagrebu, Medicinski fakultet; 2016.
 19. Krajčin S, Ovčina A, Mehmedika T, Palalić H, Hajdarević A, Eminović E, et al. Management of professional stress among healthcare managers. *Med Journal.* 2023;29(4): 176-82.
 20. Miljković S. Motivacija zaposlenih i modifikovanje ponašanja u zdravstvenim organizacijama. *Acta Medica Medianae.* 2007;46(2):53-62.
- Declaration of Patient's Consent:** the authors certify that they have obtained the appropriate patient consent forms. In the form, the patients have granted their permission for the images and other clinical information to be reported in the journal.
- Authors' Contributions:** MG, AO, MČ, SDž and ADž contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
- Financial Support and Sponsorship:** nil.
- Conflict of Interest:** there are no conflicts of interest.

Comparison of Microbiological Causative Agents of Pneumonia after Tracheobronchial Suctioning

Komparacija mikrobiološkog uzročnika pneumonije uzrokovane mehaničkom ventilacijom nakon zatvorene i otvorene traheobronhalne sukcije

Jasmina Hadžić^{1*}, Amina Herić¹, Alma Mizdrak¹, Senada Džebo², Samela Zelić³, Mirsada Čustović⁴

¹Clinic of Infectious Disease, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

²Head Nurse, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

³Clinic of Emergency Medicine, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

⁴Department for Quality and Safety of Healthcare Services, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

***Corresponding author:** Jasmina Hadžić, Infectious Diseases Clinic, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina, Email: hadzicjasminac3@gmail.com

ABSTRACT

Introduction: Ventilator-associated pneumonia (VAP) is a type of hospital-acquired infection defined as pneumonia occurring 48 hours after intubation of a patient and initiation of mechanical ventilation. The incidence is 20-70% of intubated patients and is associated with a high mortality rate (33-50%). The causative agents are usually bacteria, susceptible or resistant strains depending on the time of onset.

Aim: to examine factors that influence the occurrence of VAP, such as duration of mechanical ventilation, type of disease and surgical procedures, ventilation route (endotracheal tube or cannula) and the use of various therapeutic procedures; to analyze the microbiological causes of VAP from bronchoaspirates in a group of patients in whom tracheobronchial tree aspiration was performed using the open or closed aspiration method, and to determine the outcome of treatment in both groups.

Materials and methods: the study was conducted as an analytical retrospective-prospective clinical study and it included 60 patients treated in the Intensive Care Unit of the Clinic of Anesthesia and Resuscitation of the Clinical Center University of Sarajevo. The data from medical documentation, medical history and patient protocols were used for the research. Based on the previously analyzed literature, it was concluded that the simplest way to designate patients was as group A (patients who underwent tracheobronchial aspiration using the open method) and group B (a group of patients who underwent tracheobronchial aspiration using the closed method).

Results: standard statistical methods were used in the processing of the obtained parameters, which include determining the mean (X), standard deviation (SD) and percentage calculation. To test the significance of the differences between their arithmetic means, a

T-test type 2 was used for two samples with approximately equal variances. To determine the sample with equal or different variances, the F-test was used. To test the hypothesis, a 2-criteria H2-test was used.

Conclusion: based on the conducted research and the obtained results, the following conclusions were drawn: in both groups of patients, factors that favor the development of VAP were present: the duration of mechanical ventilation was longer in group B. Continuous use of sedatives during MV was in 50% of cases in group A, while in group B it was present in 33% of patients. After analyzing the microbiological agents, it was concluded that the same microbiological agents were present in both groups and that the presence was not significantly significant ($p=0.734$), which proved the null hypothesis of the study. Also, *Acinetobacter baumannii* was significantly present as the cause of VA infection in both groups ($p=0.00001$).

Keywords: VAP, open and closed aspiration method, comparison of microbiological agents of bronchial aspirate

SAŽETAK

Uvod: pneumonija uzrokovana mehaničkom ventilacijom (VAP/*ventilator associated pneumonija*) je vrsta intrahospitalne infekcije i definiše se kao pneumonija nastala 48 sati nakon intubacije pacijenta i započinjanja mehaničke ventilacije. Učestalost je 20-70% intubiranih bolesnika i udružena je sa visokom stopom mortaliteta (33-50%). Uzročnici su obično bakterije, osjetljivi ili rezistentni sojevi u zavisnosti od vremena nastanka.

Cilj: ispitati faktore koji imaju utjecaj na pojavu VAP-a: dužina mehaničke ventilacije, vrsta bolesti i operativnih zahvata, put ventilacije (endotrahealni tubus ili kanila) i primjena različitih terapijskih postupaka. Analizirati mikrobiološke uzročnike VAP-a iz bronhoaspirata kod grupe bolesnika kojima je aspiracija traheobronhalnog stable izvođena metodom otvorene, odnosno zatvorene aspiracije, te utvrditi ishod liječenja kod obje grupe.

Materijali i metode: ispitivanje je urađeno kao analitički retrospektivno - prospektivna klinička studija koja je obuhvatila 60 pacijenata liječenih u Jedinici intenzivne terapije Klinike za anesteziju i reanimaciju KCUS-a. Za istraživanje su korišteni podaci iz medicinske dokumentacije, historije bolesti i protokola pacijenata. Na osnovu prethodno analizirane literature koja je vršena, zaključeno je da najjednostavnije pacijente označiti kao grupa A (pacijenti kojima je sprovedena traheobronhalna aspiracija otvorenom metodom) i grupa B (grupa pacijenata kod kojih se provodi traheobronhalna aspiracija zatvorenom metodom).

Rezultati: u obradi dobivenih parametara korištene su standardne statističke metode, koje uključuju određivanje srednje vrijednosti (X), standardne devijacije (SD) i procentualnog računa. Za testiranje značajnosti razlika između njihovih aritmetičkih sredina, korišten je T-test tip 2 za dva uzorka s približno jednakim varijancama. Za utvrđivanje uzorka s jednakim ili različitim varijancama koristili smo F-test. Za testiranje hipoteze korišten je H2-test 2 kriterija.

Zaključak: na temelju provedenog istraživanja i dobivenih rezultata izvedeni su sljedeći zaključci: u obje grupe pacijenata su prisutni faktori koji pogoduju nastanku VAP-a: dužina mehaničke ventilacije je bila duža u grupi B. Kontinuirana primjena sedativa tokom MV je bila u 50% slučajeva u grupi A, dok je u grupi B bila zastupljena kod 33% pacijenata. Nakon analize mikrobioloških uzročnika da se zaključiti da su u obje grupe prisutni isti mikrobiološki uzročnici i da zastupljenost nije signifikantno značajna ($p=0,734$) čime se dokazuje nulta hipoteza istraživanja. Također, signifikantno je prisutan *Acinetobacter baumannii* kao uzročnik VA infekcije u obje grupe ($p=0,00001$).

Ključne riječi: VAP, otvorena i zatvorena metoda aspiracije, komparacija mikrobioloških uzročnika bronhalnog aspirate

INTRODUCTION

Ventilator-associated pneumonia (VAP) is a type of hospital-acquired infection and is defined as

pneumonia occurring within 48 hours of intubation and initiation of mechanical ventilation (1).

The incidence is 20-70% of intubated patients and is associated with a high mortality rate of 33-50%. Ventilator-associated pneumonia in surgical patients (VAP) in the intensive care unit is the second most common form of hospital-acquired infection and a leading cause of mortality (2).

The trigger for the development of VAP is an open path for bacteria, via the lower respiratory tract, through the endotracheal tube or tracheostomy (passage of subglottic and gastric contents around the cuff of the endotracheal tube, due to low pressure in the cuff), as well as contaminated parts of the anesthesia machine or respirator for artificial ventilation (3).

Microbiological control is one of the most important obligations in intensive care units, in order to prevent ventilator-associated pneumonia.

The pathophysiology of ventilator-associated pneumonia in VAP patients involves two main processes:

1. Bacterial colonization of the respiratory and digestive tracts (the presence of bacteria without clinical manifestations of the disease).
2. Microabsorption of contaminated oropharyngeal secretions from the upper to the lower respiratory tract.

Numerous risk factors in critically ill patients that favor the development of pneumonia are associated with mechanical ventilation. Many years of research have identified multiple factors that increase the likelihood of developing this nosocomial infection. The risk of developing VAP exists as long as the patient requires ventilation. Risk factors for VAP are divided into those related to the host and those related to interventions during the ICU stay. Some procedures and conditions promote colonization of the respiratory system (e.g., antibiotic administration), and some increase the possibility of aspiration (e.g., supine position, sedation, head trauma). Pre-existing diseases

of patients are a significant risk factor for the development of infection with specific pathogens. In patients with ARDS, VAP is often caused by *S. Aureus*, *P. aruginosa* and *Acinetobacter baumannii*, and multiple pathogens are often isolated simultaneously. ⁽⁴⁾

AIM

The aim of this study was to examine factors that influence the occurrence of VAP in patients of both groups: duration of mechanical ventilation, type of disease and surgical procedures, ventilation route (endotracheal tube or cannula) and application of different therapeutic procedures (type of sedation and previous antimicrobial therapy); to analyse the microbiological causes of VAP from bronchoaspirates in a group of patients in whom tracheobronchial tree aspiration was performed using the open aspiration method; to analyse the microbiological causes of VAP from bronchoaspirates in a group of patients in whom tracheobronchial tree aspiration was performed using the closed aspiration method and to determine the outcome of treatment in relation to the groups.

MATERIALS AND METHODS

The study included 60 patients treated in the Intensive Care and Therapy Unit at the Clinic of Anesthesia and Resuscitation of the Clinical Center University of Sarajevo (CCUS) in the period from 1 January 2018 to 1 January 2020.

Patients were divided into two groups:

- Group A (n=30) - patients undergoing tracheobronchial aspiration using the open method
- Group B (n=30) - patients undergoing tracheobronchial aspiration using the closed method

Criteria for inclusion in the study:

- Patients of both sexes over 18 years of age
- Patients with ventilator-dependent pneumonia

Criteria for exclusion from the study:

- Patients on mechanical ventilation for less than 48 hours

The study was conducted as an analytical retrospective - prospective clinical study.

The research used data from medical documentation, medical history and protocols of intensive care patients hospitalized at the CCUS Clinic of Anesthesia and Resuscitation.

RESULTS

The average age in the total sample (N=60) was 52.6±13.2 years, with the youngest patient being 18, and the oldest 86. The average age of group A respondents was 58.6±16.4 years, while the average age of group B respondents was 46.5±23.2 years. Analysis using the Student’s t test for independent samples showed that the sample was not homogeneous by age with t=2.332 and p=0.0023.

In the examined group A, 66.67% of respondents were male, and 33.33% were female. The examined group B consisted of 43.33% of male and 56.67% of female patients. We could say that the groups by gender were homogeneous, with p<0.05.

The average duration of hospitalization in the total sample (N=60) was 12.8±6.9 days, with the shortest duration of hospitalization being 3, and the longest 28 days. The average duration of hospitalization of group A respondents was 13.4±7.2 days, while the average duration of hospitalization of group B respondents was 11.7±6.3 days. Analysis using the Student’s t test for independent samples showed that there was no statistically significant difference in the duration of hospitalization between the groups, (p>0.05).

The minimum duration of mechanical ventilation was 2 days, whereas the maximum number of days was 15 days in group A and 16 days in group B. The average duration of mechanical ventilation in group A was 7.5±6.5 days and in group B 8.2±5.5 days. Based

on the presented data and p>0.05, we could conclude that there was no significant difference in the duration of mechanical ventilation between the groups.

Table 1 Percentage of patients who underwent mechanical ventilation via endotracheal tube or cannula in both groups.

	Group A	Group B	Total
Endotracheal tube	22 (73.3%)	19 (63.3%)	41 (68.3%)
Cannula	8 (26.7%)	11 (36.7%)	19 (31.7%)
Total	30 (100.0%)	30 (100.0%)	60 (100.0%)

$\chi^2=0.693$; p=0.405

The endotracheal tube was used more frequently in both groups compared to the cannula. Thus, in group A, the endotracheal tube was used in 22 or 73.3% of cases, while the cannula was used in 8 or 26.7% of cases. In group B, the endotracheal tube was used in 19 or 63.3% of cases, while the cannula was used in 11 or 36.7% of cases.

Statistical analysis indicates that there was no significant difference in the use of the endotracheal tube or cannula according to the groups (p>0.05).

Table 2 Relationship between internal medicine and surgical patients with VAP, in both groups.

	Group A	Group B	Total
Surgical	19 (63,3%)	12 (40,0%)	31 (51,7%)
Internist	11 (36,7%)	18 (60,0%)	29 (48,3%)
Total	30 (100,0%)	30 (100,0%)	60 (100,0%)

$\chi^2=3,27$; p=0,060

Although a slightly higher proportion of patients in group A underwent surgical treatment - 63.3% compared to 40% of respondents in group B, this difference was not statistically significant, (p>0.05).

Table 3 Types of surgery in both groups.

	Group A	Group B	Total
Abdomen	7 (36.8%)	2 (16.7%)	9 (29.0%)
Thorax	6 (31.6%)	7 (58.3%)	13 (41.9%)
Neurotrauma	6 (31.6%)	3 (25.0%)	9 (29.0%)
Total number of operations	19 (61.3%)	12 (38.7%)	31 (100.0%)

$\chi^2,396=2; p=0,302$

Analysis of the types of surgical procedures in group A showed that the total of 19 surgical procedures performed on the abdomen (36.8%), chest (31.6%) and neurotrauma (31.6%) were almost equally represented. Out of a total of 12 surgical procedures in group B, surgical procedures on the chest (41.9) were more represented than surgical procedures on the abdomen (29% each).

Statistical analysis indicated that there was no significant difference in the representation of surgical procedures by groups, ($p>0.05$).

Table 4 Relation between internal medicine and surgical patients with VAP in both groups.

Pulmonary complications	Surgical	Internist	Total
Emphysema	5 (16.1%)	1 (3.4%)	6 (10.0%)
HOPB	7 (22.6%)	3 (10.3%)	10 (16.7%)
Asthma	2 (6.5%)	2 (6.9%)	4 (6.7%)
Previous pneumonia	1 (3.2%)	0 (0.0%)	1 (1.7%)

Analysis of chronic lung diseases in relation to the type of patient (surgical/internal medicine) showed that almost all diseases were more prevalent in the surgical patient group, except for asthma, which was slightly more prevalent in internal medicine patients.

Statistical analysis did not show a significant difference in the prevalence of chronic lung diseases between the groups, ($p>0.05$).

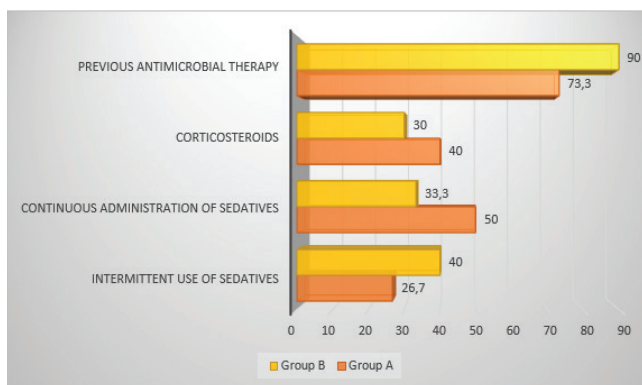


Figure 1 Relation between therapeutic procedures in relation to groups.

The ratio of therapeutic procedures according to the groups showed that the intermittent administration of sedatives was more frequent in group B with 40% compared to 26.7% in group A, while the continuous administration of sedatives was more frequent in group A with 50% compared to 33.3% in group B. The use of corticosteroids was more frequent in group A with 40% compared to 30% in group B. Earlier antimicrobial therapy was slightly more often used in group B in 90% cases compared to 73.3% of group A cases.

Table 5 Comparison of microbiological agents of bronchial aspirate in respondents.

	Group A	Group B	Total
Acinetobacter baumannii	16 (53.3%)	18 (60.0%)	34 (58.3%)
Pseudomonas aeruginosa	9 (30.0%)	5 (16.7%)	14 (23.3%)
Proteus mirabilis	1 (3.3%)	1 (3.3%)	2 (3.3%)
Escherichia coli	1 (3.3%)	1 (3.3%)	2 (3.3%)
Klebsiella pneumoniae	2 (6.6%)	2 (6.7%)	4 (6.6%)
Candida albicans	0 (0.0%)	2 (6.7%)	2 (3.3%)
MSSA	1 (3.3%)	1 (3.3%)	2 (3.3%)
Total	30 (50.0%)	30 (50.0%)	60 (100.0%)

$\chi^3,578=2; p=0,734$

Although there was a certain higher prevalence of isolates *Acinetobacter baumannii* (60:53.3%), *Klebsiella pneumoniae* (6.7:3.3%) and *Candida albicans* (6.7:0.0%) in group B, and *Pseudomonas aeruginosa* in group A (30.0:16.7%), these differences were not recorded as statistically significant, with $p > 0.05$. Analysis of the prevalence of individual isolates in the total sample (n=60) showed that there was a statistically significantly higher prevalence of *Acinetobacter baumannii* compared to other isolates ($\chi^2=15.311$; $p=0.0001$; $p < 0.05$).

Table 6 MBL isolates in a bronchoaspirate sample taken via an endotracheal tube or cannula with an open suction system.

Bronchoaspirate isolates	Tube	Cannula	Total
<i>Acinetobacter baumannii</i>	13 (59.1%)	3 (37.5%)	16 (53.3%)
<i>Pseudomonas aeruginosa</i>	6 (27.3%)	3 (37.5%)	9 (30.0%)
<i>Proteus mirabilis</i>	0 (0.0%)	1 (12.5%)	1 (3.3%)
<i>Escherichia coli</i>	1 (4.5%)	0 (0.0%)	1 (3.3%)
<i>Klebsiella pneumoniae</i>	0 (0.0%)	2 (25.0%)	2 (6.6%)
<i>Candida albicans</i>	0 (0.0%)	0 (0.0%)	0 (0.0%)
MSSA	1 (4.5%)	0 (0.0%)	1 (3.3%)
Totla	21 (100.0%)	9 (100.0%)	30 (100.0%)

$\chi^2_{8,869}=2$; $p=0.114$

Analysis of isolates in bronchoaspired samples showed that in samples taken with an open suction system via an endotracheal tube, *Acinetobacter baumani*, *Escherichia coli* and MSSA were more prevalent.

In the case of cannula, the following isolates were more frequently recorded: *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Klebsiella pneumoniae*. Statistical analysis did not show a significant difference between isolates taken via an endotracheal tube or cannula, ($p > 0.05$).

Table 7 MBL isolates in a bronchoaspirate sample taken via an endotracheal tube or cannula with a closed suction system.

	Tube	Cannula	Total
<i>Acinetobacter baumannii</i>	10 (52.6%)	8 (72.7%)	18 (60.0%)
<i>Pseudomonas aeruginosa</i>	3 (15.8%)	2 (18.2%)	5 (16.7%)
<i>Proteus mirabilis</i>	1 (5.3%)	0 (0.0%)	1 (3.3%)
<i>Escherichia coli</i>	0 (0.0%)	1 (9.1%)	1 (3.3%)
<i>Klebsiella pneumoniae</i>	2 (10.5%)	0 (0.0%)	2 (6.7%)
<i>Candida albicans</i>	1 (5.3%)	0 (0.0%)	1 (3.3%)
MSSA	2 (10.5%)	0 (0.0%)	2 (6.7%)
Total	19 (100.0%)	11 (100.0%)	30 (100.0%)

$\chi^2_5=2.025$; $p=0.413$

Analysis of isolates in bronchoaspirate samples showed that in samples taken with an open suction system via the endotracheal tube, *Acinetobacter baumani*, *Escherichia coli* and MSSA were more prevalent.

In the case of the cannula, the following isolates were more frequently recorded: *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Klebsiella pneumoniae*. Statistical analysis did not show a significant difference between isolates taken via the endotracheal tube or cannula, ($p > 0.05$).

Table 8 Comparison of MBL isolates obtained by open and closed suction endotracheal tube.

	Group A	Group B	Total
Acinetobacter baumannii	13 (59.1%)	10 (52.6%)	23 (56.1%)
Pseudomonas aeruginosa	6 (27.3%)	3 (15.8%)	9 (21.9%)
Proteus mirabilis	0 (0.0%)	1 (5.3%)	1 (2.4%)
Klebsiella pneumoniae	0 (0.0%)	2 (10.5%)	2 (4.9%)
Escherichia coli	1 (4.5%)	0 (0.0%)	1 (2.4%)
MRSA	1 (4.5%)	2 (10.5%)	3 (7.3%)
Total number of samples	21 (100.0%)	18 (100.0%)	39 (100.0%)

$\chi^2=2.521$; $p=0.355$

Comparison of MBL isolates from open and closed suction obtained via endotracheal tube in all combinations showed that in group A, Acinetobacter baumannii was more prevalent with 59.1% of cases, Pseudomonas aeruginosa with 27.3% and Escherichia coli with 4.5%, while in group B, Proteus mirabilis was more prevalent with 5.3% and MRSA with 10.5%.

Statistical analysis did not show a significant difference between isolates obtained via endotracheal tube, ($p>0.05$).

Table 9 Comparison of open and closed suction MBL isolates obtained via cannula.

	Group A	Group B	Total
Acinetobacter baumannii	3 (37.5%)	8 (72.7%)	11 (57.9%)
Pseudomonas aeruginosa	3 (37.5%)	2 (18.2%)	5 (26.3%)
Proteus mirabilis	1 (12.5%)	0 (0.0%)	1 (5.3%)
Escherichia coli	0 (0.0%)	1 (9.1%)	1 (5.3%)
Klebsiella pneumoniae	1 (12.5%)	0 (0.0%)	1 (5.3%)
Total samples taken	8 (100.0%)	11 (100.0%)	19 (100.0%)

$\chi^2=3.777$; $p=0.287$

Comparison of MBL isolates from open and closed suction obtained via cannula showed that in group A only Klebsiella pneumoniae was more prevalent with 50%, while the other isolates were more prevalent in group B, specifically Acinetobacter baumannii with 63.6%, Pseudomonas aeruginosa with 63.6% and MRSA with 45.5%.

Statistical analysis did not show a significant difference between isolates taken via endotracheal cannula, ($p>0.05$).

Table 10 Treatment outcome of the respondents in relation to the groups.

Treatment outcome	Group A	Group B	Total
Successfully cured	18 (60.0%)	24 (80.0%)	42 (70.0%)
Egzitus letalis	12 (40.0%)	6 (20.0%)	18 (30.0%)
Total	30 (100.0%)	30 (100.0%)	60 (100.0%)

$\chi^2=2,857$; $p=0,909$

In group B, the cure rate was higher (80%) compared to group A (60%). The p-value was 0.9, which indicated that there was a difference between these two methods in the outcome of treatment compared to the groups. However, the p-value showed that that was still not a statistically significant difference and could not be taken as a rule.

Table 11 Relation between cause and death in both groups.

	Group A	Group B	Total
Acinetobacter baumannii	6 (50.0%)	2 (33.3%)	8 (44.4%)
Pseudomonas aeruginosa	4 (33.3%)	2 (33.3%)	6 (33.3%)
Klebsiella pneumoniae	1 (8.3%)	1 (16.7%)	2 (11.1%)
MRSA	1 (8.3%)	1 (16.7%)	2 (11.1%)
Total deaths	12 (66.7%)	6 (33.3%)	18 (100.0%)

$\chi^2=2.526$; $p=0.639$

Analysis of the correlation between the causative agent and the death outcome in both groups showed that in group A, deaths were more frequent in the case of *Acinetobacter baumannii* (50% of the total number of deaths in group A). Deaths in patients with *Pseudomonas aeruginosa* isolates were equally represented in both groups with 33.3% each, while deaths were more frequent in group B in respondents with *Klebsiella pneumoniae* and MRSA isolates with 16.7% each.

Statistical analysis showed that there was no significant difference in the frequency of deaths according to isolates between the groups, ($p>0.05$).

DISCUSSION

Ventilator-associated pneumonia (VAP) in surgical patients in the Intensive Care Unit is the second most common form of hospital infection and is a leading cause of mortality. Therefore, this study aimed to compare the open and closed method of tracheobronchial tree suction in patients in the Intensive Care Unit of the Clinic of Anesthesia and Resuscitation as one of the significant factors in the development of VAP infection.

In clinical practice, decompensated respiratory failure is the most common indication for mechanical ventilation of the lungs in Intensive Care Units.

Ventilator-associated pneumonia (VAP) is a type of hospital-acquired infection and is defined as pneumonia that occurs 48 hours after intubation of patients and initiation of mechanical ventilation (5,6).

The study included 60 ICU patients on mechanical ventilation for over 48 hours (2018–2020). The average age was 52.6 years, with a significant age difference between groups ($p=0.0023$), but no significant difference in gender distribution ($p>0.05$).

Ventilation lasted an average of ~8 days in both groups, with no statistical difference ($p>0.05$). Microbiological analysis showed different pathogens

but no significant difference in type or number between groups. Group B (closed suction) had more *Acinetobacter baumannii*, *Klebsiella pneumoniae*, and *Candida albicans*, while *Pseudomonas aeruginosa* was more common in group A (open suction).

Surgical patients were more common in group A, but the difference was not significant. Therapeutic procedures, such as sedation, corticosteroid, and antibiotic use, also showed no significant differences.

Endotracheal tubes were more frequently used than cannulas, with similar rates of reintubation and reinsertion across groups ($p>0.05$). MBL pathogen distribution varied but was not statistically significant between suction methods or airway types.

The average hospital stay was 12.8 days. Mortality was more often associated with *A. baumannii* in group A and with *K. pneumoniae* and MRSA in group B, without significant differences. The cure rate was higher in group B (80%) than in group A (60%), but this difference was not statistically significant ($p=0.9$).

VAP represents a major epidemiological, diagnostic, therapeutic and economic problem. Treatment of VAP is long-term, demanding and represents a significant financial cost for the institution in which the treatment is carried out and the causative agents are often resistant to drug therapy. The occurrence of VAP cannot be completely prevented, but with the right approach we can effectively limit it. The first step in the prevention of pneumonia caused by mechanical ventilation is the education of healthcare personnel, i.e. learning about risk factors and preventive measures when carrying out daily healthcare around patients on mechanical ventilation. All measures from hand hygiene, sterilization of medical instruments, implementation of surgical aseptic procedures, application of disinfectants and other procedures for the purpose of pneumonia prevention should be equally represented in the daily activities of the entire healthcare system. More frequent microbiological/epidemiological controls of all employees in JINJ are necessary. It is necessary to regularly monitor the latest research in the prevention and treatment of pneumonia (7).

A well-organized healthcare system and institution are aware that every dollar spent on infection control pays off many times over, because preventing hospital infections is an integral part of health care which, if inadequately implemented, tarnishes the reputation of the entire healthcare system.

In one of their earlier studies, Koleff et al. reported that the incidence of VAP (ventilator-associated pneumonia) among surgical patients was 21.6% higher compared to the incidence among internal medicine patients, which according to their data was 9.3%. They also point out that the incidence of VAP is highest in trauma patients (8).

In a 2012 study conducted at a referral hospital in Seoul, Su Young Chi, et al. found that the two most common causes of VAP, regardless of early or late onset of the disease, were *Staphylococcus aureus* and *Acinetobacter baumannii* (9).

Jongerden IP, et al., in a study published in the journal *Critical Care* in 2007, reported that there was no statistically significant difference in the incidence of VAP infections in relation to the use of open or closed suction methods in a sample of 1272 patients. Based on the results obtained, they concluded that the choice of method should depend on other factors, such as: costs and individual patient needs (10).

Charari A, et al., in a study conducted in 2013 at the University Hospital of Tunis, confirmed that VAP caused by infection with *Acinetobacter baumannii* had a mortality rate in the intensive care unit of 60.9% (11).

CONCLUSION

Based on the study results, both groups showed risk factors for VAP, including prolonged mechanical ventilation (8.2 days in group B vs. 7.5 in group A), higher rates of surgical patients (63.3% in group A vs. 40% in group B), and more frequent use of endotracheal tubes and continuous sedation in group A.

The most common pathogen in both groups was *Acinetobacter baumannii* (53.3% in group A, 60% in

group B), followed by *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. There was no statistically significant difference in pathogen distribution between groups ($p=0.734$), confirming the null hypothesis. However, *A. baumannii* was significantly associated with VAP in both groups ($p=0.00001$).

Treatment outcomes were better in group B (80% cured) compared to group A (60%).

REFERENCES

1. Dudeck MA, Horan TC, Peterson KD, Allen-Bridson K, Morrell G, Anttila A, et al National Healthcare Safety Network (NHSN) report, data summary for 2010, device-associated module. *Am J Infect Control.* 2013;41(4):286-300. doi: 10.1016/j.ajic.2013.01.002.
2. Elmmansoury A, Seid H. Closed suction system versus open system. *Egyptian Journal of Chest Diseases and Tuberculosis.* 2017;66(3):509-15. doi: org/10.1016/j.ejcdt.2016.08.001
3. Rello J, Ollendorf DA, Oster G, Vera-Llonch M, Bellm L, Redman R, et al. Epidemiology and outcomes of ventilator-associated pneumonia in a large US database. *Chest.* 2002;122(6):2115-21. doi: 10.1378/chest.122.6.2115.
4. Fagon JY, Chaster J. Diagnosis and treatment of nosocomial pneumonia in ALI/ARDS patients. *Eur Respir J Suppl.* 2003;42:77s-83s. doi: 10.1183/09031936.03.00421203.
5. Sanaie S, Rahnemayan S, Javan S, Shadvar K, Saghaleini SH, Mahmoodpoor A. Comparison of Closed vs Open Suction in Prevention of Ventilator-associated Pneumonia: A Systematic Review and Meta-analysis. *Indian J Crit Care Med.* 2022 Jul;26(7):839-845. doi: 10.5005/jp-journals-10071-24252.
6. Liang Z, Liao Q, Xu J, Wang S, Liu Q, Liu Z, et al. Comparative analysis of open and closed tracheal suction systems on mechanical ventilation efficiency in adults: A systematic review and meta-analysis. *Aust Crit Care.* 2025 Mar;38(2):101106.

- doi: 10.1016/j.aucc.2024.08.003.
7. Gahan AK, Jain S, Khurana S, Chawla D. Closed versus open endotracheal tube suction in mechanically ventilated neonates: a randomized controlled trial. *Eur J Pediatr.* 2023;182(2):785-793. doi: 10.1007/s00431-022-04726-y.
 8. Kollef MH, Morrow LE, Neiderman MS, Leeper KV, Anzueto A, Benz-Scott L, et al. Clinical characteristics and treatment patterns among patients with ventilator-associated pneumonia. *Chest.* 2006;129(5):1210-8. doi: 10.1378/chest.129.5.1210.
 9. Chi SY, Kim TO, Park CW, Yu YI, Lee B, Lee HS, et al. Bacterial Pathogens of Ventilator Associated Pneumonia in a Tertiary Referral Hospital. *Tuberc Respir Dis (Seoul).* 2012 Jul;73(1):32-7. doi: 10.4046/trd.2012.73.1.32.
 10. Jongerden IP, Rovers MM, Grypdonck MH, Bonten MJ. Open and closed endotrachea suction systems in mechanically ventilated intensive care patients: a meta-analysis. *Crit Care Medicine.* 2007;35(1):260-70. doi: 10.1097/01.CCM.0000251126.45980.E8.
 11. Chaari A, Mnif B, Bahloul M, Mahioubi F, Chtara K, Turki O, et al. *Acinetobacter baumannii* ventilator-associated pneumonia: epidemiology, clinical characteristics, and prognosis factors. *Int J Infect Dis.* 2013 Dec;17(12):e1225-8. doi: 10.1016/j.ijid.2013.07.014.

the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Financial Support and Sponsorship: nil.

Conflict of Interest: there are no conflicts of interest.

Declaration of Patient's Consent: the authors certify that they have obtained the appropriate patient consent forms. In the form, the patients have granted their permission for the images and other clinical information to be reported in the journal.

Authors' Contributions: JH, AH, AM, SDž, SZ and MČ contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to

The Influence of Tradition on the Eating Habits of Patients on Hemodialysis - The Experience of One Center

Uticaj tradicije na prehrambene navike pacijenata na hemodijalizi - iskustvo jednog centra

Vahida Hodžić^{1,*}, Maja Bećarević, Arnela Zec, Azra Džubur, Mevlida Sejdinović

Nephrology Clinic & BNT, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

***Corresponding author:** Hodžić Vahida, Nephrology Clinic & BNT, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina, Email:vahida.hodzoc@gmail.com

ABSTRACT

Introduction: proper nutrition is very important in creating good conditions for the quality of life and survival of patients on a chronic hemodialysis program.

Aim: to determine the relationship between the quality and quantity of nutrition and fluid intake of patients on a chronic hemodialysis program with body mass index (BMI), and the impact of nutrition on the regulation of hypertension with regard to gender, age, length of hemodialysis treatment, and the presence of diabetes, to analyze the level of acquired knowledge about nutrition in patients, and the influence of tradition in choosing foods in the diet.

Materials and methods: the study included 84 patients undergoing chronic hemodialysis treatment. The studied group of patients completed a questionnaire, which contained questions related to the foods they use in their diet, fluid intake and the type of food they consume very often. One of the questions was related to the consumption of a traditional Bosnian dish, i.e. pies, filled with various fillings, in relation to the consumption of fish in the weekly menu.

Results: the research included 84 patients, 57 (67.86%) men and 27 (32.14%) women. The average age was 56.31 ± 12.34 years, the duration of

hemodialysis treatment was 71.2 ± 56.7 months. 56 (66.6%) patients had high blood pressure, above the limit values of 140/90 mmHg, and all of them used prescribed antihypertensive drugs. 51 (60.71%) had a normal BMI, 8 (9.52%) had a high BMI, 12 (14.29%) had a high BMI, and 13 (15.48%) had a too high BMI, while there were no malnourished patients. All examined patients regularly consumed all kinds of Bosnian pie in the amount of 150-500 grams, once or more times a week. There is a significant statistical difference $p < 0.05$ in blood pressure values between patients who ate pie in an amount greater than 300 grams and several times a week, compared to patients who consumed it less often and less (100-150 gr.). 25 (29.76) patients used fish in their diet, while 59 (70.24%) did not. As for fluids, they usually took 500ml-2l of water per day, and patients who took more fluids had a higher interdialysis excess. The most common answer to the question about the importance of following the diet was that the food was tasty, while 23 (27.38%) respondents answered that it complied with the recommendations.

Conclusion: the influence of tradition has been confirmed by this research, and despite warnings, most patients are not ready to eliminate undesirable products from their diet. However, in order to fully analyze the eating habits of patients, socio-economic

circumstances, education, cultural habits, environmental influence, cooperation and others should also be taken into account.

Keywords: nutrition, hemodialysis, tradition

SAŽETAK

Uvod: pravilna ishrana je veoma važna u stvaranju dobrih uslova za kvalitet života i preživljavanje pacijenata na programu hronične hemodijalize.

Cilj: utvrditi odnos između kvaliteta i kvantiteta ishrane i unosa tečnosti kod pacijenata na hroničnom programu hemodijalize sa indeksom tjelesne mase (BMI), i uticaja ishrane na regulaciju hipertenzije s obzirom na pol, dob, dužinu liječenja hemodijalizom i prisustvo dijabetesa, analizirati nivo stečenog znanja o ishrani kod pacijenata i uticaj tradicije na izbor namjernica u ishrani.

Materijali i metode: studija je obuhvatila 84 pacijenta na hroničnom hemodijaliznom liječenju. Ispitivana grupa pacijenata popunila je upitnik koji je sadržavao pitanja vezana za namjernice koje koriste u ishrani, unos tečnosti i vrstu hrane koju često konzumiraju. Jedno od pitanja se odnosilo na konzumiranje tradicionalnog bosanskog jela, tj. pita, punjenih raznim nadjevima, u odnosu na konzumiranje ribe u sedmičnom meniju.

Rezultati: istraživanjem je obuhvaćeno 84 pacijenta, 57 (67,86%) muškaraca i 27 (32,14%) žena. Prosječna starost je bila $56,31 \pm 12,34$ godine, trajanje hemodijalize je bilo $71,2 \pm 56,7$ mjeseci. 56 (66,6%) pacijenata je imalo visok krvni pritisak, iznad graničnih vrijednosti od 140/90 mmHg, i svi su koristili propisane antihipertenzivne lijekove. 51 (60,71%) je imalo normalan BMI, 8 (9,52%) visok BMI, 12 (14,29%) visok BMI, a 13 (15,48%) previsok BMI, dok nije bilo pothranjenih pacijenata. Svi pregledani pacijenti redovno su konzumirali sve vrste bosanskih pita u količini od 150-500 grama, jednom ili više puta sedmično. Postojala je značajna statistička razlika, $p < 0,05$, u vrijednostima krvnog pritiska između pacijenata koji su jeli pitu u količini većoj od 300 grama

i nekoliko puta sedmično, u poređenju sa pacijentima koji su je jeli rjeđe i manje (100-150 gr.). Ribu u ishrani koristilo je 25 (29,76) pacijenata, dok 59 (70,24%) nije. Što se tiče tečnosti, obično su unosili 500ml-2l vode dnevno, a pacijenti koji su unosili više tečnosti imali su veći interdijalizni višak. Najčešći odgovor na pitanje o važnosti pridržavanja dijeta je bio da je hrana ukusna, dok je 23 (27,38%) ispitanika odgovorilo da je bila u skladu s preporukama.

Zaključak: ovim istraživanjem je potvrđen uticak tradicije i uprkos upozorenjima, većina pacijenata nije bila spremna izbaciti nepoželjne proizvode iz svoje ishrane. Međutim, kako bi se u potpunosti analizirale prehrambene navike pacijenata, treba uzeti u obzir i socio-ekonomske okolnosti, obrazovanje, kulturne navike, uticaj okoline, saradnju i drugo.

Cljučne riječi: ishrana, hemodijaliza, tradicija

INTRODUCTION

Nowday, in the Europe and rest of the world there is a silent epidemic of chronic kidney diseases. More than 500 million people suffer from kidney disease in the world, it means that every tenth adult has some kind of kidney disease. About 1.5 million people in the world live due to the artificial replacement of kidney function, while the average waiting time for a kidney transplant is about seven years. Chronic kidney disease (CKD) is a gradual, progressive decrease in glomerular filtration rate (GFR) caused by the deterioration of a large number of nephrons. The number of patients in the terminal stage of kidney disease is constantly increasing in Bosnia and Herzegovina, as well as in most other countries, especially in developed countries. Due to the increasing number of patients with chronic kidney failure and their high mortality rate, it is necessary, if possible, to slow down the progression of kidney failure, and on the other hand, to prevent numerous complications that are a consequence of damage to kidney function (1).

Proper nutrition is very important for good condition and for the quality of life and survival of

patients on a chronic hemodialysis (HD) program. Nutrition for patients on HD includes: adequate amounts of nutrients, protective and other substances in the appropriate amount and ratio (proteins, fats, carbohydrates, vitamins, minerals, trace elements and water). Proper and balanced nutrition prevents comorbid conditions, such as: obesity, diabetes mellitus, hyperlipoproteinemia, which are the cause of accelerated atherosclerosis and ischemic heart disease, malnutrition, hyperkalemia, bone changes caused by elevated blood phosphate levels (renal osteodystrophy), cardiac decompensation, due to constant and intermittent hypervolemia, etc. (2).

Nutrition is a very important component in the complex treatment system of all patients on hemodialysis. It has been confirmed that inadequate nutrition in these patients is associated with increased morbidity and mortality, as well as delayed rehabilitation and poor overall quality of life (3).

Despite ever-increasing improvement of hemodialysis treatment, its success and efficiency significantly depends on the adequate nutrition of the patients. The prevalence of malnutrition, which includes undernutrition and overnutrition, in HD patients varies between 10 and 50%. In order to diagnose malnutrition, it is very important, in addition to socio-demographic characteristics such as: sex, age, marital status, business and mental status, to take into consideration the lifestyle or eating style, and as part of this information, what type of food the patient prefers. (2) Traditional Bosnian cuisine is rich in various types of dishes, which sometimes contain foods that are not recommended in the diet of dialysis patients. Despite this, acquired eating habits cannot be completely ruled out. The tradition of eating pies, i.e. savajaka, filled with different fillings (cheese, meat, potatoes, spinach, etc.) is widespread in Bosnia, while the consumption of some foods such as fish is not unique to this area. Body mass index (BMI) is very important for diagnosing malnutrition, which belongs to anthropometric measurements and is used as an indicator of a person's level of nutrition and represents the ratio of body mass in kilograms to the square of

body height, and in hemodialysis patients it should not be less than 23.0 nor more than 30.0 kg/m² (3).

Over time, patients on regular HD therapy experience changes in body composition, but not necessarily in BMI (the proportion of muscle mass decreases, thereby increasing the risk of protein-energy malnutrition). Based on several studies, more than 50-60% of patients on hemodialysis (up to 85% in some reports) are hypertensive (2).

Patients with chronic renal failure consume fewer calories than the daily recommended dose and therefore often develop nutritional deficits. Patients with end-stage chronic renal failure should consume 30 kcal/kg/day, which value should be adjusted to the patient's physical activity (4).

AIM

The aim of the study was to determine the relationship between the quality and quantity of nutrition and fluid intake of patients on a chronic hemodialysis program with body mass index (BMI), and the impact of nutrition on the regulation of hypertension with regard to gender, age, length of hemodialysis treatment, and the presence of diabetes, to analyze the level of acquired knowledge about nutrition in patients, and the influence of tradition in choosing foods in the diet.

MATERIALS AND METHODS

The study included 84 patients undergoing chronic hemodialysis at our Center. The study group completed a questionnaire, which contained questions related to the foods they use in their diet, fluid intake, and the type they most often consume. One of the questions related to the frequency of consuming a traditional Bosnian dish, i.e. pie, filled with various fillings, in relation to the consumption of fish in the weekly menu.

RESULTS

Table 1 Structure of the test sample.

Pa- tients	Gender				Diabetics		Age	Length of dialysis (months)
	Male		Female		n	%		
	n	%	n	%				
84	57	67,86	27	32,14	17	20,24	56,31±12,34	71,2±56,7

The study included 84 patients, (67.86%) men and (32.14%) women, the average age was 56.31 ±12.34 years, the duration of hemodialysis treatment was 71.2 ±56.7 months, and of the total number, 20.24% of patients were diabetics.

Table 2 Values of Body Mass Index/BMI/ in the examined sample.

BMI	Male		Female		Total	
	n	%	n	%	n	%
Too low (male < 20,7, female < 19,1)	0	0	0	0	0	0
Ideal (male 20,7-26,4 female 19,1-25,8)	35	61,40	16	59,26	51	60,71
Slightly high (male 26,5-27,8 female 25,9-27,3)	6	10,53	2	7,41	8	9,52
High (male 27,9-31,1, female 27,4-32,3)	9	15,79	3	11,11	12	14,29
Too high (male 31,2-45, female 32,4-45)	7	12,28	6	22,22	13	15,48
Total	57	100,00	27	100,00	84	100,00

Out of the total number of 84 subjects, ideal (BMI) was determined in 51 patients, slightly high in 8, high in 12, while too high BMI was determined in 13 patients.

Table 3 Blood pressure values in the examined sample.

Patients	BLOOD PRESSURE			
	< 140/90 mmHg		> 140/90 mmHg	
	n	%	n	%
84	28	33,24	56	66,86

Out of a total of 84 examined patients, elevated blood pressure (above 140/90 mm Hg) was recorded in 56, while in the remaining 28 patients the pressure was within normal limits.

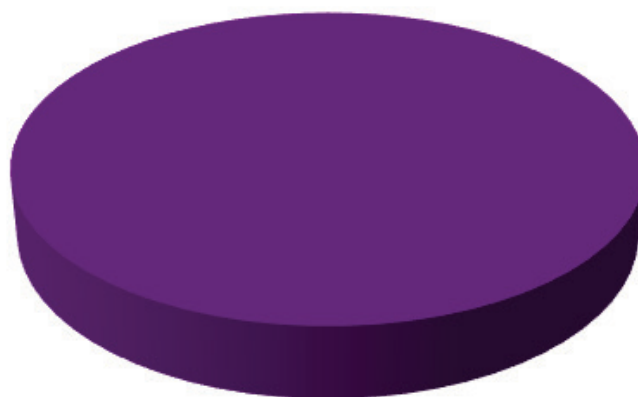


Figure 1 Patient’s weekly pie consumption.

All respondents (84 patients) consume the traditional Bosnian pie, in varying quantities on a weekly basis.



Figure 2 Patient’s weekly fish consumption.

Out of the total number of patients (84), only 21 (25%) patients consume fish once a week, while other patients consume fish extremely rarely or not at all.

Table 4 Nutrition of patients considering the consumption of pie in the weekly menu.

Nutrition of patients Pie consumption (cheese, meat, potatoes and spinach)	BLOOD PRESSURE					
	< 140/90		> 140/90		Total	
	n	%	n	%	n	%
100-150 gr. 1 X weekly	17	48,57	18	51,43	35	41,67
150-300 gr. 1X weekly	6	26,09	17	73,91	23	27,38
> od 300 gr. 1 X weekly	4	26,67	11	73,33	15	17,86
300-500 gr. 2-3 X weekly	1	9,09	10	90,91	11	13,10
Total:	28	33,33	56	66,67	84	100,00

Analysis of the frequency and amount of pie consumption in relation to blood pressure values revealed a statistically significant difference (p<0.05). Among patients who consumed pie in an amount of 300-500 grams several times a week, 90.91% had elevated blood pressure (above 140/90 mm Hg), compared to patients who consumed it less frequently (once a week) and in smaller amounts.

Table 5 Daily fluid intake in relation to interdialysis excess.

Patients	Fluid intake			
	<500ml IV=500-2000 ml		500-2000ml IV>2000 ml	
	n	%	n	%
84	20	23,84	64	76,16

Out of a total of 84 patients, 20 of them consume less than 500 ml of fluid per day, and the interdialysis excess in this group is smaller. The remaining 64 patients consume between 500 and 2000 ml of fluid per day, and their interdialysis excess is greater than 2000 ml.

Table 6 The importance of adhering to a hygienic-dietary diet.

Patients	The importance of adhering to a hygienic-dietary diet			
	In accordance with the recommendations		That it's delicious	
	n	%	n	%
84	23	27,38	61	72,62

Out of a total of 84 patients, when asked about the importance of adhering to a hygienic-dietary diet, 23 patients responded that they did, while 61 patients stated that the most important thing for them was that the food was tasty.

DISCUSSION

The study included 84 patients, 57 (67.86%) men and 27 (32.14%) women, the average age was 56.31 ± 12.34 years, the duration of hemodialysis treatment was 71.2 ± 56.7 months. 56 (66.6%) patients had elevated blood pressure, above the threshold of 140/90 mmHg, and all were using prescribed antihypertensive drugs. BMI was normal in 51 (60.71%), elevated in 8 (9.52%), high in 12 (14.29%), and too high in 13 (15.48%) patients, while there were no malnourished patients in the study sample. All patients consumed all types of pie, in an amount of 150-500 grams once or more times a week. There is a significant statistical difference p<0.05 in HTA values between patients who take pie in an amount greater than 300 grams and several times a week, compared to patients who take it less often and less (100-150 gr.). 25 (29.76%) patients use fish in their diet, while 59 (70.24%) do not use it at all. They usually take water in the amount of 500ml - 2l per day, and patients who take more fluids have a higher interdialysis excess. A patient on hemodialysis should limit fluid intake according to the amount of urine excreted during 24 hours, i.e. according to the remaining diuresis. The recommended daily fluid intake is about 500 ml, increased by the amount of urine excreted (5).

In addition to water, fluid intake includes juices and various beverages (eg coffee, tea, milk, soups, etc.) (6). The most common answer to the question about the importance of following the diet is that the food is tasty, while 23 (27.38%) respondents answered that it is in accordance with the recommendations.

Rački S, et al. (2010) conducted a study that included the importance of malnutrition, inflammation and atherosclerosis in hemodialysis patients. The results showed that in 62.2% of patients, the combination of these factors was the cause of death (5).

Mikolašević I, et al. (2014) indicate that malnutrition in hemodialysis patients has numerous negative consequences, including reduced resistance to infections and loss of amino acids during hemodialysis, which can reach up to 12% of daily intake. According to their data, the incidence of malnutrition in these patients can be up to 80% (6).

Čala S, et al. (2005) state that, according to numerous studies, between 18% and even 80% of patients treated with hemodialysis have some form of malnutrition, which confirms the widespread prevalence of this problem (7).

That is why, according to Bašić-Jukić N, et al. (2015), nutritional counseling is an important part of the treatment of patients with chronic renal failure. The authors point out that every hemodialysis center should have at least one nurse or technician specially trained in the nutrition of kidney patients (8).

CONCLUSION

This research confirms the significant influence of tradition on the dietary habits of hemodialysis patients. Regardless of education and medical warnings, most patients are still not ready to eliminate undesirable products from their diet. This indicates the importance of taking into account the broader context, including socio-economic circumstances, education, cultural habits, environmental influences and patient cooperation, when planning nutritional support. Also, in order to improve treatment and prevent complications caused by improper nutrition, it is necessary to provide an adequate hygienic-dietary regimen. This not only prolongs the life expectancy of patients, but also significantly contributes to increasing their quality of life. A key role in this process is played by medical staff, who, in addition to medical monitoring, must also act as educators, advisors and psychological support. Since they spend up to 15 hours a week with patients, it is important that they are well-educated and aware of their impact on the outcome of treatment. Without this, even the most advanced technology will not be enough to achieve the desired results in dialysis

treatment. Introduce additional educational programs for patients that include not only medical aspects of nutrition, but also social and cultural obstacles to changing habits. Ensure the presence of specially trained nurses - nutrition technicians in each dialysis center. Assess individual factors such as socio-economic status, education and the influence of the environment when creating a dietary regime. Increase the awareness of the medical staff about the importance of their role in the education and emotional support of patients. Introduce regular monitoring of nutritional status and include nutritionists as a permanent part of the dialysis team.

REFERENCES

1. Petković D. Ishrana bolesnika na hemodijalizi i procjena stanja uhranjenosti. *Nefro*. 2012;12(29):6.
2. Resić H, Mešić E, Alečković M, Kukavica N. Klinički aspekti hemodijalize. Sarajevo: IKD University Press - Magistrat izdanja, Editio Medica; 2013. p.147-61, 337-40.
3. Resić H, Čengić B. Dijaliza – moj način života. Sarajevo: Udruženje ljekara za nefrologiju, dijalizu i transplantaciju bubrega u BiH – Magistrat; 2011. p.161-4.
4. Halovanić G. Prehrana bolesnika na liječenju dijalizom. *Nursing Journal*. 2014;19(2):128.
5. Rački S, Vujčić B, Bubić I, Mrakovčić-Šutić I, Kes P, Dvirnik Š, et al. Kliničko značenje sindroma pothranjenosti, upale i ateroskleroze u bolesnika na redovitoj hemodijalizi. *Medicina Fluminensis*. 2010;46:519-32.
6. Mikolašević I, Orlić L, Vidrih S, Poje B, Bubić I, Vujičić B, et al. Procjena nutritivnog statusa u bolesnika s kroničnom bubrežnom bolesti koji se liječe redovitom hemodijalizom. *Acta Med Croatica*. 2014;68:97-102.
7. Čala S, Janković N, Pavlović D, Šprem Ž, Pirički Ž. Prehrana bolesnika s zatajenjem bubrega. Zagreb: Hrvatsko društvo za nefrologiju, dijalizu i transplantaciju; 2005.
8. Bašić-Jukić N, Radić J, Klarić D, Jakić M, Vujičić B,

Gulin M, et al. Preporuke za praćenje, prevenciju i liječenje proteinsko-energijske pothranjenosti u bolesnika s kroničnom bubrežnom bolesti. Liječ Vjesn. 2015;137:1-8.

Declaration of Patient's Consent: the authors certify that they have obtained the appropriate patient consent forms. In the form, the patients have granted their permission for the images and other clinical information to be reported in the journal.

Authors' Contributions: VH, MB, AZ, ADŽ and MS contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Financial Support and Sponsorship: nil.

Conflict of Interest: there are no conflicts of interest.

Assessment of Quality of Life in Patients with Diabetic Foot after Surgical Treatment

Procjena kvaliteta života kod pacijenata sa dijabetičkim stopalom nakon operativnog tretmana

Emina Nikšić^{1*}, Almedina Alihodžić^{1,2}, Elvira Turulja¹ Almera Borčilo¹ Žana Macanović¹, Elma Hrbinja¹ Samira Gajević³

¹Clinic of Orthopedics and Traumatology, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

²Faculty of Health Studies, University of Sarajevo, Bardakčije 1, 71000 Sarajevo, Bosnia and Herzegovina

³Public Institute for Addiction Disorders of Canton Sarajevo, Nahorevska 173, 71000 Sarajevo, Bosnia and Herzegovina

Corresponding author: Emina Nikšić, 1Clinic of Orthopedics and Traumatology, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina, Email: emina.omerhodzic@yahoo.com

ABSTRACT

Introduction: according to the definition of the World Health Organization, a diabetic foot is a foot with impaired functional integrity due to infection, wounds, and tissue destruction, as well as nerve damage and vascular disease. Epidemiological studies estimate that 25% of individuals with diabetes mellitus will develop foot problems during their lifetime, and 5% to 15% will undergo lower limb amputation. Quality of life is a very relevant aspect when observing disease outcomes and the success of therapeutic procedures. A diabetic foot is the foot of a patient suffering from diabetes mellitus with a potential risk of various pathological consequences, including infection, ulceration, and/or deep tissue destruction.

Aim: to assess the quality of life of patients with diabetic foot and determine the number of surgical procedures performed.

Materials and methods: this was a clinical-retrospective study conducted at the Clinic of Orthopedics and Traumatology of the Clinical Center University of Sarajevo. The study included 60 patients

of both genders, aged 25 to 75 years, treated for diabetic foot. Data were collected from medical records and surgical reports, as well as by using the WHOQOL-BREF questionnaire.

Results: patients who did not undergo repeated surgical procedures had the highest quality of life scores, while the greatest satisfaction with quality of life was reported in patients who underwent debridement (30%). A total of 73.3% of patients had only one surgical procedure, whereas 26.7% underwent repeated surgery. Higher quality of life scores were observed in patients who underwent timely surgical treatment, which significantly contributed to better quality of life and treatment outcomes.

Conclusion: timely diagnosis and adequate surgical treatment are crucial for reducing complications and improving functional outcome.

Keywords: diabetic foot, surgical procedures, quality of life

SAŽETAK

Uvod: prema definiciji Svjetske zdravstvene organizacije dijabetičko stopalo je ono stopalo koje je narušenog funkcionalnog integriteta zbog infekcije, rana i razaranja tkiva, te oštećenja živaca i bolesti krvnih žila nogu. Temeljem epidemioloških studija procjenjuje se da će 25% osoba sa diabetesom melitusom tokom života razviti probleme sa stopalima, a 5% do 15% biti podvrgnuto amputaciji nogu. Kvalitet života predstavlja veoma aktuelan vid posmatranja ishoda oboljenja i uspješnosti terapijske procedure. Dijabetičko stopalo je stopalo pacijenta koji boluje od dijabetesa melitusa sa potencijalnim rizikom od niza patoloških posljedica, uključujući infekciju, ulceraciju i/ili destrukciju dubokih tkiva.

Cilj: procijeniti kvalitet života pacijenata s dijabetičkim stopalom i utvrditi broj operativnih zahvata.

Materijali i metode: istraživanje je kliničko-retrospektivnog tipa, provedeno na Klinici za ortopediju i traumatologiju Kliničkog centra Univerziteta u Sarajevu. Uključeno je 60 pacijenata oba spola, starosti od 25 do 75 godina, liječenih zbog dijabetičkog stopala. Podaci su prikupljeni iz medicinske dokumentacije i operativnih izvještaja, te korištenjem WHOQOL-BREF upitnika.

Rezultati: pacijenti su imali veću ocjenu kvaliteta života koji nisu imali ponovljene operativne zahvate, najveće zadovoljstvo kvalitetom života je kod pacijenata sa debridmanom 30% slučajeva, kod 73,3% pacijenta radilo o prvom operativnom zahvatu, dok je 26,7% pacijenata podvrgnuto ponovljenom operativnom zahvatu. Veća je ocjena kvaliteta života pacijenata koji su se na vrijeme javili na tretman operativnog zahvata, koji nisu imali ponovljene operativne zahvate, što značajno doprinosi kvaliteti i uspješnosti liječenja bolesnika te poboljšanju kvaliteta života.

Zaključak: pravovremena dijagnoza i adekvatan hirurški tretman ključni su za smanjenje komplikacija i poboljšanje funkcionalnog ishoda

Ključne riječi: dijabetičko stopalo, operativni zahvati, kvalitet života

INTRODUCTION

According to the definition of the World Health Organization, the diabetic foot is a foot with impaired functional integrity due to infection, wounds and tissue destruction, and damage to nerves and blood vessels (1). Epidemiological studies estimate that approximately 25% of people with diabetes mellitus will develop foot complications during their lifetime, while between 5% and 15% of them will undergo amputation of the leg (2). Quality of life is an important indicator of the outcome of the disease and the success of therapeutic procedures (3). The diabetic foot is defined as the foot of patients with diabetes mellitus that is exposed to a high risk of various pathological changes, including infections, ulcerations and destruction of deep tissues (4). The use of a surgical treatment protocol for the diabetic foot is associated with fewer complications and better treatment outcomes.

AIM

The aim of this study was to assess the quality of life of patients with diabetic foot and determine the number of surgical procedures.

MATERIALS AND METHODS

The study was a clinical-retrospective, conducted at the Clinic of Orthopedics and Traumatology of the Clinical Center University of Sarajevo. The study included 60 patients of both sexes, aged 25 to 75 years, treated for diabetic foot. Data were collected from medical records and surgical reports, and using the WHOQOL-BREF questionnaire. The life satisfaction scale was Likert-type (1-5), and the maximum possible score was 160 points.

RESULTS

The research was conducted at the Clinic of Orthopedics and Traumatology of the Clinical Center

University of Sarajevo. The research included 60 respondents, the analysis of gender distribution in the total sample showed that there were 41 male and 19 female patients. In terms of age distribution, the average age of respondents in the total sample was 62.4 years, with a median of 63 years, the youngest respondent being 27 and the oldest 85. The most common surgical procedure at the first surgery was debridement in 18 or 30% of cases, followed by amputatio cruris or amputatio halluci in 13 or 21.7% of cases.

Globally, patients who had a repeat operation, showed a lower level of satisfaction or rated their quality of life lower after the operation.

Statistically significant differences were recorded in the spheres of physical and mental health, and without a significant impact on social relations and relations with the environment. That indicated that the type of operation certainly had an impact on the quality of life after the operation.

Table 1 Analysis of the types of operative procedures during the first procedure.

	Operative intervention during surgery	
	N	%
Debridman	18	30.0
Amputatio cruris	13	21.7
Resectio capiti ossis metatarsalis	11	18.3
Amputatio halluci	13	21.7
Semiamputatio pedis	5	8.3
Total	60	100.0

The most common surgical procedure at the first surgery was debridement in 18 or 30% of the cases, followed by amputation of the leg or amputation of the big toe in 13 or 21.7% of the cases.

Resection of the metatarsal head was used in 11 or 18.3% of surgical procedures, while the least frequently used surgical procedure was semi amputation of the foot in 5 or 8.3% of the cases.

Table 2 Analysis of the types of surgical interventions during repeated surgery.

	Surgical procedure during resurgery	
	N	%
Debridman	2	12.5
Amputatio cruris	5	31.3
Resectio capiti ossis metatarsalis	2	12.5
Amputatio halluci	3	18.8
Semiamputatio pedis	4	25.0
Total	16	26.7
NP	44	73.3
Total	60	100.0

In 16 patients who underwent repeated surgery, the most common was amputatio cruris in 5 or 31.3%, followed by semiamputatio pedis in 4 or 25% of the cases, amputatio halluci in 3 or 18.8%, and in two cases or 12.5% debridement and resectio capiti ossis metatarsalis.

Table 3 Comparison of the average scores of the World Health Organization QOL questionnaire according to the type of surgery.

	Surgical procedures					
	N	Average	Standard deviation	Standard error	Minimum	Maximum
Debridman	18	68.32	13.41	3.16	32.14	85.71
Amputatio cruris	13	49.84	18.51	5.13	25.00	85.71
Resectio capiti ossis metatarsalis	11	61.44	15.61	4.71	39.29	85.71
Amputatio halluci	13	63.74	22.72	6.30	14.29	96.43
Semiamputatio pedis	5	65.00	13.69	6.12	50.00	75.00
Total	60	61.78	18.08	2.33	14.29	96.43

F=3.266 p=0.044

Mental health F=3.183; p=0.043	Debridman	18	66.11	15.65	3.69	25.00	87.50
	Amputatio cruris	13	56.73	10.42	2.89	41.67	75.00
	Resectio capiti ossis metatarsalis	11	54.85	12.26	3.70	37.50	79.17
	Amputatio halluci	13	56.73	13.67	3.79	25.00	79.17
	Semiamputatio pedis	5	69.17	17.58	7.86	50.00	83.33
	Total	60	60.24	14.32	1.85	25.00	87.50
Social relationship F=1.748 p=0.153	Debridman	18	71.25	19.65	4.63	12.50	100.00
	Amputatio cruris	13	67.31	14.32	3.97	41.67	87.50
	Resectio capiti ossis metatarsalis	11	65.76	15.84	4.77	37.50	91.67
	Amputatio halluci	13	80.77	20.17	5.59	50.00	100.00
	Semiamputatio pedis	5	61.67	11.18	5.00	50.00	75.00
	Total	60	70.65	17.98	2.32	12.50	100.00
Environment F=0.897; p=0.472	Debridman	18	67.25	12.42	2.93	45.00	90.63
	Amputatio cruris	13	59.47	12.57	3.49	43.75	81.25
	Resectio capiti ossis metatarsalis	11	60.80	9.65	2.91	40.63	71.88
	Amputatio halluci	13	62.23	15.74	4.36	25.00	81.25
	Semiamputatio pedis	5	64.73	7.04	3.15	57.14	71.88
	Total	60	63.08	12.48	1.61	25.00	90.63

Generally, patients who underwent debridement showed the highest satisfaction with quality of life, and those who underwent amputatio cruris the lowest.

Statistically significant differences were recorded in the spheres of physical and mental health, and without a significant impact on social relations and relations with the environment.

That indicated that the type of operation certainly had an impact on the quality of life after the operation.

Table 4 Comparison of the average scores of the World Health Organization QOL questionnaire according to the first or repeated surgery.

		Surgery or resurgery					
		N	Average	Standard. deviation	Standard. error	Minimum	Maximum
Physical health t=1.981; p=0.165	Surgery	44	67.19	11.01	2.75	42.86	85.71
	Resurgery	16	59.82	19.78	2.98	14.29	96.43
	Total	60	61.78	18.08	2.33	14.29	96.43
Mental health t=5.810; p=0.019	Surgery	44	67.34	14.06	3.51	45.83	87.50
	Resurgery	16	57.65	13.67	2.06	25.00	83.33
	Total	60	60.24	14.32	1.85	25.00	87.50
Social relationship t=1.253; p=0.268	Surgery	44	72.22	17.07	2.57	37.50	100.00
	Resurgery	16	66.35	20.21	5.05	12.50	100.00
	Total	60	70.65	17.98	2.32	12.50	100.00
Environment t=1.558; p=0.217	Surgery	44	66.40	13.25	3.31	45.00	90.63
	Resurgery	16	61.88	12.11	1.83	25.00	81.25
	Total	60	63.08	12.48	1.61	25.00	90.63

Globally, patients who had a repeated surgery showed a lower level of satisfaction or rated their quality of life lower after the surgery. Thus, the ratio in the case of the physical health satisfaction scale was 67.2:59.8%, the mental health satisfaction scale was 67.3:57.7%, the social relationships satisfaction scale was 72.2:66.4% and the relationship satisfaction scale was 66.4:61.9%. A statistically significant effect or difference was recorded only in the case of the psychological functioning scale (p<0.05).

DISCUSSION

The results of our study suggested similarities with the literature on surgical treatment of diabetic foot. Debridement is still considered the initial method in the treatment of diabetic foot complications, and in our study it was performed in 30% of the subjects (5).

Similar findings have been recorded in the literature; for example, Game FL, et al. pointed out that regular and adequate debridement is a fundamental component in reducing the progression and complications of diabetic foot ulcers, significantly

improving healing outcomes and reducing the risk of infection and amputation (6).

Lower leg amputation remains the gold standard in advanced cases, and in our study it was performed in 21.7% of patients, which was in accordance with the results of other authors (7).

A large multicenter European study involving 1,229 diabetic patients with new foot ulcers found that nearly one-third of patients presented with both peripheral arterial disease (PAD) and infection, indicating a higher severity of foot disease than previously reported. The study also showed that non-plantar ulcers were more common, especially among patients with advanced disease, who additionally had more significant tissue loss, comorbidities, and were generally old (8).

Quality of life after surgical treatment of diabetic foot ulcers varies significantly depending on multiple factors. According to Dias et al. psychological distress and patients' perception of the disease have a stronger impact on quality of life than the size of the ulcer itself. Their study of 70 patients with diabetic foot ulcers showed that larger ulcers and higher psychological distress were associated with lower quality of life scores. These findings highlight the importance of addressing psychological factors alongside surgical treatment to improve overall patient outcomes (9).

Quality of life in patients with diabetic foot ulcers is influenced not only by the severity of the ulcer but also by psychological and social factors. A systematic review by Smith-Strøm H, et al. (2018) emphasized that depression and anxiety are common in this patient group and strongly correlate with worse health-related quality of life. The authors concluded that multidisciplinary care, including psychological support and patient education, is essential to improve outcomes and quality of life in diabetic foot patients (10).

Recent research confirms the importance of a multidisciplinary approach. In 2022, Perrin BM, et al. showed that patients with an increased risk of ulceration had significantly lower scores in the physical and general health domains on the SF-36 scale (11).

Recent studies also emphasize the role of patient

education and self-care in reducing complications and improving quality of life. A randomized controlled trial by Dorresteyn JA, et al. demonstrated that structured education programs focusing on foot care significantly reduced the incidence of new foot ulcers and improved patients' self-management skills (12).

This underlines the importance of empowering patients as part of the multidisciplinary approach.

In addition to education, the use of advanced wound care technologies has shown promising results. Armstrong DG, et al. reported that the application of negative pressure wound therapy (NPWT) accelerates healing rates in diabetic foot ulcers, reduces hospital stay, and lowers healthcare costs. Their multicenter trial confirmed that NPWT is an effective adjunct to standard surgical and medical care (13).

Moreover, vascular interventions remain crucial in patients with peripheral arterial disease complicating diabetic foot ulcers. Hinchliffe RJ, et al. highlighted that revascularization procedures, including endovascular and surgical bypass, improve limb salvage rates and reduce major amputations, particularly when performed early in the disease course (14).

Finally, emerging therapies such as stem cell and growth factor treatments offer hope for patients with severe and non-healing diabetic foot ulcers. A meta-analysis by Guo S, et al. confirmed that stem cell therapies significantly improve wound healing and microcirculation, with a marked reduction in amputation rates when compared to conventional treatments (15).

CONCLUSION

The type of surgical procedure has a significant impact on the quality of life of patients with diabetic foot. Timely diagnosis and adequate surgical treatment are crucial for reducing complications and improving functional outcome. Our results indicate that a properly selected surgical method, especially debridement performed in the early phase, significantly reduces the risk of progression of ulceration and amputation.

REFERENCES

1. Badanjak A, Duvnjak L, Kolarić V. Dijabetičko stopalo-možemo činiti više. *Hrvatski časopis za javno zdravstvo*. 2016; 12(46): 70-4.
2. Pavić S, Švrtlih N, Simonović. J, Delić. D. Influence of depression on the quality of life in patients with chronic hepatitis C. *Srpski arhiv za celokupno lekarstvo*. 2011;139(9-10):645-50.
3. Heljić B, et al. *Dijabetologija*. Medicinski fakultet Univerziteta u Sarajevu. Sarajevo: 2011.
4. Weledji EP, Fokam P. Treatment of the diabetic foot – to amputate or not? *BMC Surg*. 2014;14:83. doi: 10.1186/1471-2482-14-83.
5. Dayya D, O’Neill OJ, Huedo-Medina TB, Habib N, Moore J, Iyer K. Debridement of Diabetic Foot Ulcers. *Adv Wound Care (New Rochelle)*. 2022 Dec;11(12)
6. Game FL, Hinchliffe RJ, Apelqvist J, Armstrong DG, Bakker K, Hartemann A, Löndahl M, Price PE, Jeffcoate WJ. A systematic review of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev*. 2012
7. Molina CS, Faulk JB. *Amputacija donjih ekstremiteta*, NLM, 2022.
8. Prompers L, Huijberts M, Apelqvist J, Jude E, Piaggese A, Bakker K, Edmonds M, Holstein P, Jirkovska A, Mauricio D, Ragnarson Tennvall G, Reike H, Spraul M, Uccioli L, Urbancic V, Van Acker K, van Baal J, van Merode F, Schaper N. High prevalence of ischaemia, infection and serious comorbidity in patients with diabetic foot disease in Europe. Baseline results from the Eurodiale study. *Diabetologia*. 2007
9. Dias Â, Ferreira G, Vilaça M, Pereira MG. Quality of Life in Patients with Diabetic Foot Ulcers: A Cross-sectional Study. *Adv Skin Wound Care*. 2022
10. Smith-Strøm H, Igland J, Østbye T, Tell GS, Hausken MF, Graue M, Skeie S, Cooper JG, Iversen MM. The Effect of Telemedicine Follow-up Care on Diabetes-Related Foot Ulcers: A Cluster-Randomized Controlled Noninferiority Trial. *Diabetes Care*. 2018
11. Perrin BM, van Netten JJ, Aan de Stegge WB, Busch-Westbroek TE, Bus SA. Health-related quality of life and associated factors in people with diabetes at high risk of foot ulceration. *J Foot Ankle Res*. 2022
12. Dorresteijn JA, Kriegsman DM, Assendelft WJ, Valk GD. Patient education for preventing diabetic foot ulceration. *Cochrane Database Syst Rev*. 2014 Dec 3;(12):CD001488.
13. Armstrong DG, Lavery LA, Marston W, et al. Negative pressure wound therapy after partial diabetic foot amputation: a multicenter, randomized controlled trial. *Lancet*. 2017;386(9988):1649-1657.
14. Hinchliffe RJ, Andros G, Apelqvist J, et al. A systematic review of the effectiveness of revascularization of the ulcerated foot in patients with diabetes and peripheral arterial disease. *Diabetes Metab Res*
15. Guo S, Li X, Sun Y, et al. Stem cell therapy for diabetic foot ulcers: a meta-analysis. *Stem Cell Res Ther*. 2021 Sep 10;12(1):470.

Declaration of Patient’s Consent: the authors certify that they have obtained the appropriate patient consent forms. In the form, the patients have granted their permission for the images and other clinical information to be reported in the journal.

Authors’ Contributions: EN, AA, ET, AB, ŽM, EH and SG contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Financial Support and Sponsorship: nil.

Conflict of Interest: there are no conflicts of interest.

Evaluation of Sex And Age Effect on the Urinary Albumin/Creatinine Ratio Test

Procjena uticaja spola i starosti na test omjera albumina i kreatinina u urinu

Selvedina Dužkan^{1,2*}, Aleksandra Pašić^{1,2}, Gogić Dalila¹, Ermin Begović¹, Sanela Hajro^{1,2}, Suzana Tihic- Kapidžić¹

¹Clinical Biochemistry and laboratory Medicine, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

²Faculty of Health Studies, University of Sarajevo, Bardakčije 2, 71000 Sarajevo, BiH

***Corresponding author:** Selvedina Dužkan, Clinical Biochemistry and Laboratory Medicine, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina, Email:selvedina75@hotmail.com

ABSTRACT

Introduction: the urine albumin-creatinine ratio (uACR) is a widely used marker for detecting early kidney damage, as elevated levels indicate albuminuria, a sign of compromised renal function. Currently, reference ranges are applied uniformly across populations, without adjustments for age or sex. This study investigates whether age and sex influence uACR levels, aiming to determine if individualized reference ranges could improve early detection and patient management.

Materials and methods: this retrospective study analyzed 213 uACR test results obtained over the period of six months (May-October 2024). Out of this number, 108 results with normal values (0-3 mg/mmol) were included for reference range assessment. The study population comprised 54 males and 54 females. Participants were divided into three age groups: 18-39, 40-59, and 60-80 years of age. Data analysis employed SPSS software, utilizing Mann-Whitney U, Kruskal-Wallis, and Spearman correlation tests, with a significance threshold of $p < 0.005$.

Results: the mean uACR value across the total population was 0.94 ± 0.73 mg/mmol, with no significant difference between males and females

($p=0.556$). Age analysis revealed significant differences in uACR among the three age groups ($p=0.009$), with the highest mean in the 60-80 years group (1.06 mg/mmol) and the lowest in the 18-39 years group (0.53 mg/mmol). A positive correlation between age and uACR was observed (Spearman's $\rho=0.248$, $p=0.01$), indicating that uACR tends to increase with age.

Conclusion: the study demonstrates that while sex does not significantly affect uACR levels, age is a significant factor influencing albuminuria. The findings support the need for age-adjusted reference ranges to enhance early detection of kidney disease.

Keywords: albumin/creatinine ratio, age, gender, albuminuria, kidney disease

SAŽETAK

Uvod: omjer albumina i kreatinina u urinu (uACR) široko se koristi kao marker za otkrivanje ranog oštećenja bubrega, jer povišene vrijednosti ukazuju na albuminuriju, što je znak kompromitovane funkcije bubrega. Trenutno, referentni rasponi se primjenjuju

jednako na cijelu populaciju, bez prilagodbe za starost ili spol. Ova studija istražuje da li starost i spol utiču na nivoe uACR-a, s ciljem da se utvrdi mogu li individualizirani referentni rasponi poboljšati rano otkrivanje i upravljanje pacijentima.

Materijali i metode: ova retrospektivna studija analizirala je 213 rezultata testova uACR-a prikupljenih tokom šest mjeseci (maj–oktobar 2024). Od toga, 108 rezultata sa normalnim vrijednostima (0–3 mg/mmol) uključeni su u procjenu referentnog raspona. Populacija studije obuhvatila je 54 muškarca i 54 žene. Učesnici su podijeljeni u tri starosne grupe: 18–39, 40–59 i 60–80 godina. Analiza podataka izvršena je korištenjem SPSS softvera, primjenjujući Mann-Whitney U, Kruskal-Wallis i Spearmanove korelacijske testove, s nivoom značajnosti $p < 0,005$.

Rezultati: prosječna vrijednost uACR-a u ukupnoj populaciji iznosila je 0.94 ± 0.73 mg/mmol, bez značajne razlike između muškaraca i žena ($p = 0.556$). Analiza starosti pokazala je značajne razlike u uACR-u među tri starosne grupe ($p = 0.009$), pri čemu je najviša srednja vrijednost bila u grupi od 60–80 godina (1,06 mg/mmol), a najniža u grupi od 18–39 godina (0.53 mg/mmol). Primijećena je i pozitivna korelacija između starosti i uACR-a (Spearman $\rho = 0.248$, $p = 0.01$), što ukazuje da uACR skloni rastu sa starošću.

Zaključak: studija pokazuje da spol nema značajan utjecaj na nivoe uACR-a, dok starost predstavlja važan faktor koji utiče na albuminuriju. Ovi nalazi podržavaju potrebu za uspostavljanjem starosno prilagođenih referentnih vrijednosti radi poboljšanja ranog otkrivanja bolesti bubrega.

Gljučne riječi: omjer albumin/kreatinin, starost, spol, albuminurija, bolesti bubrega

INTRODUCTION

The urine albumin-creatinine ratio (uACR) indicates the presence of albumin in the urine. Albumin is a type of protein normally found in the blood, an important nutrient that helps build muscles, repair tissues,

and fight infections, but it should not be present in urine, which is called albuminuria or proteinuria. If the kidneys are healthy, they should allow very little or no protein to pass into the urine. In case of kidney damage, proteins can “leak” from the kidneys into the urine. People with high levels of albumin in their urine are at increased risk of progressing to chronic kidney disease and eventually kidney failure (1,2).

Normal urine albumin level is less than 30 mg/g. Levels above 30 mg/g may indicate kidney disease. Besides albumin, kidney function assessment also involves measuring the concentration of creatinine excreted by the kidneys. These individual tests for kidney function show better sensitivity and specificity when used in combined analysis with the albumin/creatinine ratio (uACR) (1,3).

A high uACR may be an early sign of kidney disease, but additional examinations and repeated measurements are necessary to confirm that albuminuria is not caused by other factors. Two elevated uACR results over a prolonged period are indicative of kidney disease (1).

The uACR test is easily performed from a single first-morning urine sample and is often combined with a blood test called estimated glomerular filtration rate (eGFR). Currently, laboratory practice applies the same reference values for this very important analysis regardless of the patient’s sex and age.

AIM

The aim of this study was to determine whether there was a need to establish individual reference values based on age and sex to improve healthcare for patients.

MATERIALS AND METHODS

The study included all results of uACR tests performed at the Department of Clinical Biochemistry and Laboratory Medicine (Clinical Center University of

Sarajevo) over the period of six months (May-October 2024), after the analysis was introduced into routine laboratory practice. During this period, a total of 213 tests were conducted, and the values of albumin (mg/L), creatinine (μmol/L), and their ratio (mg/mmol) were determined in all urine samples. From the total number of tests, 108 results with normal values were included in the reference value assessment. The reference range for uACR is 0–3 mg/mmol. Data analysis was performed using SPSS software, employing non-parametric Mann-Whitney U test, Kruskal-Wallis test, and Spearman correlation test. A p-value of <0.005 was considered statistically significant.

RESULTS

The study included 54 (50%) male and 54 (50%) female participants. The average age of the total population was 58.83 ± 16.90 years. There was no significant difference in age between male and female participants, p=0.733 (Table 1). The mean uACR value in the overall population was 0.94 ± 0.73 mg/mmol. There was no significant difference in uACR values between males and females, p=0.556 (Table 1).

Table 1 Gender differences in albumin/creatinine ratio.

Parameter	Gender	N	Mean	Std. Dev.	Median	IQR (25%-75%)		Mann-Whitney U	p value
Age (years)	Male	54	58.29	17.347	63.00	46.75	71.00	1402.500	0.733
	Female	54	59.37	16.599	65.00	47.00	72.00		
Albumin/Creatinine (mg/mmol)	Female	54	0.89	0.685	0.70	0.40	1.30	1362.500	0.556
	Male	54	0.99	0.782	0.75	0.40	1.20		

In order to examine the differences according to patients' age, the total study population (N=108) was divided into three age groups: 18-39, 40-59, and 60-80 years of age. In the 18-39 age group, there were 28 (25.9%) participants; in the 40-59 age group, 20

(18.5%) participants; and in the 60-80 age group, 60 (55.6%) participants. According to the Kruskal-Wallis test, there was a statistically significant difference in uACR values among the examined age groups, p=0.009 (Table 2).

Table 2 Age differences in albumin/creatinine ratio.

Parameter	Age Group	N	Mean	Std. Dev.	Median	IQR (25%-75%)		Chi-Square	p value
Albumin/Creatinine (mg/mmol)	I (18-39)	28	0.85	0.743	0.60	0.32	1.20	9.436	0.009
	II (40-59)	13	0.53	0.425	0.40	0.20	0.90		
	III (59-80)	67	1.06	0.75	0.80	0.50	1.50		

The difference in uACR values is statistically significant between Group I and Group II, as well as between Group I and Group III (p<0.05 for both), while the difference between Group II and Group III, although present, is not statistically significant (p=0.415).

There is a statistically significant positive correlation between patients' age and uACR, with Spearman's rho=0.248 and p=0.01.

DISCUSSION

The study analyzed the impact of gender and age on the albumin-to-creatinine ratio in urine (uACR) and found that, while gender does not have a significant effect, the patient's age has a statistically significant influence on the results of this parameter.

Our findings are consistent with numerous previous studies suggesting that uACR values increase with age, which may be a consequence of natural changes in kidney function over time (4,5). In our sample, age groups differed in their mean uACR values, with the highest value recorded in the 60-80 years age group (1.06 mg/mmol), and the lowest in the youngest group, 18-39 years (0.53 mg/mmol). The presence of a statistically significant difference between the first and second, as well as the first and third age groups, indicates that age may be a factor influencing increased

albuminuria, aligning with literature reporting a decline in kidney function with age and an increased risk of kidney disease (4).

On the other hand, gender did not show a statistically significant difference in uACR values, suggesting that, in the context of this parameter, gender does not constitute a key factor. This finding is important because it indicates that reference values for uACR do not need to differ based on gender, which is consistent with some previous research. However, it is worth noting that some studies have indicated potential differences in certain populations or under the influence of other factors (6,7). On the other hand, some studies insist that Sex-related uACR cutoffs for the diagnosis of moderate albuminuria should be considered (8,9).

The correlation between age and uACR values was also statistically significant ($r=0.350$, $p=0.021$), further confirming that age is associated with increased albuminuria. Other studies have also shown a positive correlation between uACR and age (10). This highlights the importance of considering age-specific reference ranges when interpreting uACR results and developing age-adjusted reference values, as this could improve early detection of kidney disease and timely initiation of therapy.

Limitations of the study relates to a relatively small sample size and a limited data collection period, which may affect the generalizability of the results. Additionally, factors such as the presence of other diseases or medications that could influence kidney function were not thoroughly examined, and their analysis could further enhance understanding of the complexity in interpreting these results.

Future research should involve more extensive and longitudinal studies to establish specific age- and sex-specific reference values for uACR and consider additional factors such as comorbidities and lifestyle. Such data could contribute to a more personalized approach to assessing kidney function and improving patient care.

In conclusion, our results suggest that age is a significant factor in determining uACR values, while gender is not. This indicates the need for developing age-specific reference ranges, which could facilitate earlier detection of kidney disease and more effective medical monitoring.

CONCLUSION

This study did not find significant differences in uACR values based on gender but did find differences based on patients' age. The age of the subjects positively correlates with uACR values. Further comprehensive and detailed research is necessary to establish individual age-specific reference values, ultimately aimed at improving patients' healthcare.

REFERENCES

1. National Kidney Foundation. "Urine Albumin-Creatinine Ratio (uACR)." National Kidney Foundation, 1 May 2023, www.kidney.org/kidney-topics/urine-albumin-creatinine-ratio-uacr. Accessed 10 Sept. 2025.
2. Pecoits-Filho R, Bodegård J, Amberly P, Nam Y-S, Thuresson M, Svensson MK. Disease Progression, Clinical Outcomes and Treatment Challenges in Patients with Chronic Kidney Disease and High-Risk Proteinuria. *Adv Ther.* 2025. doi.org/10.1007/s12325-025-03364-8.
3. Bozkurt B, Rossignol P, Vassalotti JA. Albuminuria as a diagnostic criterion and a therapeutic target in heart failure and other cardiovascular disease. *Eur J Heart Fail.* 2025. doi: 10.1002/ejhf.3683.
4. Van der Burgh AC, Rizopoulos D, Ikram MA, Hoorn EJ, Chaker L. Determinants of the Evolution of Kidney Function With Age. *Kidney Int Rep.* 2021;6(12):3054-63. doi: 10.1016/j.ekir.2021.10.006.
5. Laha S, Mohapatra A, Sarangi R, Sahoo JP, Subhankar S. Urine Albumin-Creatinine Ratio (ACR) of Patients With Chronic Obstructive Pulmonary Disease (COPD): A Cross-Sectional Study. *Cureus.*

- 2025;17(6):e86974. doi: 10.7759/cureus.86974.
6. Liu T, Xue BL, Du B, Cui T, Gao X, Wang YY, et al. Reference values of urine protein/creatinine ratio in healthy Dalian adults. *J Clin Lab Anal.* 2021;35(11):e24043. doi: 10.1002/jcla.24043.
 7. Zheng X, Liu D, Zhu J, Lu L, Yang J. Age- and Gender-Specific Diagnostic Value of the Albumin-to-Creatinine Ratio for the Early Screening of Chronic Kidney Disease Among Middle-Aged and Elderly Males in Southeast China. *Int J Gen Med.* 2023;16:3033-42. doi: 10.2147/IJGM.S419100.
 8. Chagnac A, Friedman AN. Measuring Albuminuria in Individuals With Obesity: Pitfalls of the Urinary Albumin-Creatinine Ratio. *Kidney Med.* 2024;6(4):100804. doi: 10.1016/j.xkme.2024.100804.
 9. Ren F, Li M, Xu H, Qin X, Teng Y. Urine albumin-to-creatinine ratio within the normal range and risk of hypertension in the general population: A meta-analysis. *J Clin Hypertens (Greenwich).* 2021;23(7):1284-90. doi: 10.1111/jch.14263.
 10. Wang S, Xu B, Zhang H, Dai H, Gong J, He Y, et al. Risk factors for elevated urinary albumin/creatinine ratio in type 2 diabetes mellitus patients over 60 years old with long-term metformin use. *Medicine (Baltimore).* 2025 Jun 27;104(26):e42982. doi: 10.1097/MD.00000000000042982.

Authors' Contributions: SD, AP, GD, EB, ST-K and SH contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Financial Support and Sponsorship: nil.

Conflict of Interest: there are no conflicts of interest.

Deep Inspiration Breath Hold Techniques in Radiotherapy Treatment of Breast Cancer

Tehnike zadržavanja daha pri dubokom udisaju u radioterapijskom liječenju raka dojke

Enis Tinjak^{1*}, Nusret Salkica², Velda Smajlbegović¹, Mirjana Ristanić-Beroš¹, Amil Družić¹, Branka Metlić³

¹Oncology Clinic, Radiotherapy Department, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

²Clinic of Nuclear Medicine, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

³Department for Radiation Protection and Medical Physics, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina

***Corresponding author:** Enis Tinjak, Oncology Clinic, Radiotherapy Department, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina; Email: t-enis@hotmail.com.

ABSTRACT

Introduction: radiotherapy is one of the standard methods of breast cancer treatment. However, radiation can often have adverse reactions, especially if the heart or lungs are involved in radiation to the left side of the breast. Since irradiation of internal mammary chain lymph nodes is known to increase cardiac dose compared with whole breast or chest only treatment, reduction of cardiac dose and associated toxicity of radiotherapy may become even more important.

Aim: to show the real importance of the DIBH admission technique for the purpose of sparing organs at risk, primarily in the treatment of the left breast.

Materials and methods: in this systematic review of articles, the data collection was carried out by reviewing available scientific and professional papers related to the application of the DIBH radiation technique in breast cancer. The research was conducted by analyzing studies and publications published in the period from 2016 to 2025. The systematic literature review method enabled a structured collection and

selection of relevant publications based on keywords from scientific databases such as PubMed, ScienceDirect, Scopus, Google Scholar and Web of Science.

Results: out of the total of 8 studies analyzed in this review article on the treatment of left-sided breast cancer, 7 studies reported a 39-67% reduction in mean heart dose in DIBH compared with free breathing. Most studies also reported a significant reduction in dose to the left anterior descending coronary artery (LAD) of 20-73%.

Conclusion: the DIBH technique has become very effective in treating left breast cancer, but also right breast cancer, with significantly reduced adverse effects on the organs at risk. Technological advances in monitoring and reducing chest movement have significantly contributed to performing this technique with high precision.

Keywords: breast Ca radiotherapy, DIBH, ABC, RGSC, SGRT, toxic effects of RT on the heart and lungs

SAŽETAK

Uvod: Radioterapija je jedna od standardnih metoda liječenja raka dojke. Međutim, zračenje često može imati neželjene reakcije, posebno ako su srce ili pluća uključeni u zračenje lijeve strane dojke. Budući da je poznato da zračenje unutrašnjih limfnih čvorova marnog lanca povećava srčanu dozu u poređenju sa tretmanom cijele dojke ili samo grudnog koša, smanjenje srčane doze i povezane toksičnosti radioterapije može postati još važnije.

Cilj: pokazati stvarnu važnost tehnike prijema DIBH u svrhu očuvanja rizičnih organa, prvenstveno u liječenju lijeve dojke.

Materijali i metode: u ovom sistematskom pregledu članaka, prikupljanje podataka provedeno je pregledom dostupnih naučnih i stručnih radova koji se odnose na primjenu DIBH tehnike zračenja kod raka dojke. Istraživanje je provedeno analizom studija i publikacija objavljenih u periodu od 2016. do 2025. godine. Metoda sistematskog pregleda literature omogućila je strukturirano prikupljanje i izbor relevantnih publikacija na osnovu ključnih riječi iz naučnih baza kao što su PubMed, ScienceDirect, Scopus, Google Scholar i Web of Science.

Rezultati: od ukupno 8 studija analiziranih u ovom preglednom radu o liječenju raka lijeve strane dojke, 7 studija je prijavilo smanjenje srednje srčane doze od 39-67% kod DIBH u poređenju sa slobodnim disanjem. Većina studija je također izvijestila o značajnom smanjenju doze na lijevoj prednjoj silaznoj koronarnoj arteriji (LAD) od 20-73%.

Zaključak: DIBH tehnika je postala vrlo efikasna u liječenju raka lijeve, ali i raka desne dojke, sa značajno smanjenim negativnim efektima na rizične organe. Tehnološki napredak u praćenju i smanjenju pokreta grudnog koša značajno je doprinio izvođenju ove tehnike s visokom preciznošću.

Ključne riječi: radioterapija kalcija dojke, DIBH, ABC, RGSC, SGRT, toksični efekti RT na srce i pluća

INTRODUCTION

While radiotherapy for breast cancer is known to have both local control and survival benefits, many have questioned whether the associated toxicities and resulting mortality may actually offset some of the survival benefit (1). Hypothetically, this mortality is specifically related to cardiac mortality, and studies have shown that patients receiving radiotherapy for left-sided breast cancer have increased cardiac mortality (2). In fact, the average radiation dose to the heart correlates with rates of both cardiac death and coronary events. Although the risk of cardiac toxicity is influenced by other factors, such as the patient's baseline cardiac risk and cardiotoxic chemotherapy, these effects may not be synergistic.

The risk of cardiac disease and coronary events is estimated to increase by 4-7% for every 1 Gy in average cardiac dose, and there appears to be no minimum dose threshold below which there is no risk of cardiac events (3). Since irradiation of the internal mammary chain lymph nodes is known to increase cardiac dose compared with treatment of the whole breast or chest wall alone, reducing cardiac dose and associated toxicity from radiotherapy may become even more important (4).

Most evidence of radiation-induced cardiac damage comes from studies conducted before three-dimensional conformal radiotherapy (3DCRT) was widely used (5). However, since 3DCRT was implemented, radiation procedures have advanced, resulting in more precise, conformal treatments. Some of the techniques that have been shown to reduce cardiac dose include breast radiotherapy in the prone position (prone patient position), where the patient is simulated and treated while lying on his or her stomach to separate the breast from the heart (6). It is important to note that while modern techniques such as intensity-modulated radiation therapy (IMRT) reduce the volume of the heart that receives high doses, a larger volume can receive lower doses, due to the low scatter dose associated with this technique (7).

For locoregional radiation to the left breast, volumetric modulated arc therapy (VMAT), an IMRT approach, has shown benefits comparable to those of static IMRT in a significantly shorter time period (8). The cardiac dose for hypofractionated radiation to the left breast was reduced by 25.4% in DIBH (9).

Another technique that can be used to reduce cardiac radiation dose is the deep inspiration breath hold (DIBH). The technique is based on the observation that during inspiration, flattening of the diaphragm and expansion of the lungs moves the heart away from the chest wall. During simulation and treatment, the patient takes a deep breath and then holds his breath for a period of time during which radiation is delivered. This allows for a reduction in cardiac radiation dose. Deep and moderate deep breath hold methods were based on a modified vital capacity maneuver in which the patient exhales completely, then inhales deeply and holds his breath.

One approach to this technique is through a system and feedback that assists the patient in achieving a consistent level of breath holding using surrogates and visual aids (RGSC-Varian Medical Systems, Palo Alto, California, USA).

Another approach is computer-controlled. This approach, called active breath control, uses a spirometer and an attached valve to measure and induce breath holding at a predetermined lung volume.

Breath holding techniques during deep and normal inspiration are also currently common. Breath holding at the end of expiration is uncommon because the technique is more difficult for the patient to tolerate. Also, breath holding at the end of inspiration (especially a deep inspiration) may have some potential benefit in reducing normal tissue dose compared with breath holding at the end of expiration, because the larger lung volume reduces the average lung dose and may move targets away from structures at risk (10). Considerations for breath-hold radiotherapy are similar to the free-breathing method in that an extended treatment time is required and the technique should only be used if benefit from reducing target

motion is expected. Furthermore, patients must be able to hold their breath repeatedly, e.g. fractionation of 2 Gy on a modern linear accelerator requires 3-10 breath holds lasting 10–30 seconds, depending on pretreatment imaging, number of beams, and dose rate (11).

Deep Inspiration Breath Hold Radiotherapy Technique

There are currently two widely used methods for DIBH, moderate DIBH (mDIBH) and voluntary DIBH (vDIBH). Moderate DIBH is a technique that uses devices known as active breathing coordinators (ABCs, Elekta, Stockholm, Sweden). These devices typically use a spirometer that allows monitoring of airflow throughout the respiratory cycle and stopping airflow at a set threshold volume, causing the patient to hold their breath to maintain this volume (Figure 1) (12).

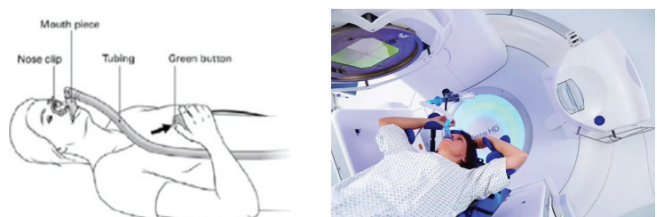


Figure 1 Presentation of the patient’s position and application of the breathing control device (ABC) in the process of performing the radiation technique, holding the breath during deep inhalation – DIBH. (<https://www.fvhospital.com/learn-more/deep-inspiration-breath-hold-and-active-breathing-coordinator>)

The ABC device consists of a nose clip that will prevent the patient from breathing through the nose, a mouthpiece and a tube that is connected to a spirometer (a device for measuring the volume of air inhaled by the lungs) and a button to stop breathing. The ABC system monitor (Figure 2) is placed near the patient to display the respiratory cycle (red or blue line) and a predefined level of lung volume that the patient needs to achieve to hold his breath (green line).

The ABC device is used during imaging on a CT simulator for treatment planning and during radiation dose delivery on a linear accelerator (Elekta).

Before performing the CT simulation procedure, patients are taught how to breathe by medical radiology engineers (radiotherapy technologists) in order to learn how to use the ABC device correctly. After repeated repetitions, the value of the air volume in the lungs and the time of holding the breath will be measured and recorded.

After completing the training, an ABC system scan is performed where CT scans are obtained during free breathing, and another set of scans during holding the breath. These CT scans are used for treatment planning.

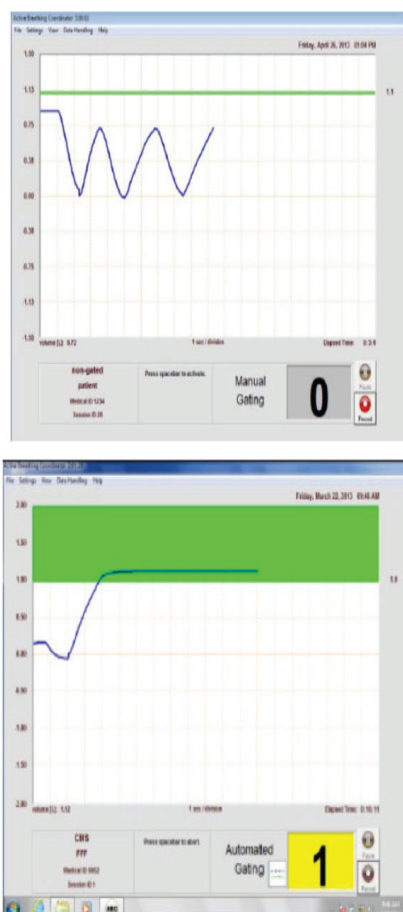


Figure 2 Display of determining the level, volume of air in the lungs and breath holding time on the ABC system. (<https://www.fvhospital.com/learn-more/deep-inspiration-breath-hold-and-active-breathing-coordinator/>)

Radiotherapy of left breast cancer is associated with certain challenges such as respiratory movements that pose a challenge to accurately deliver the dose to the target volume, and to minimize the dose to nearby critical structures, such as the heart and left lung.

Since a CT scan takes about 15 seconds, only one breath hold is required for the simulation. In order to clearly see the benefits of mDIBH for the patient, CT scans were taken while the patient was breathing freely (Figure 3). A CT scan shows a distance between the heart and the chest of 4.02 cm, while during free breathing, this distance is 2.82 cm, so mDIBH technology has expanded the distance by 1.2 cm.

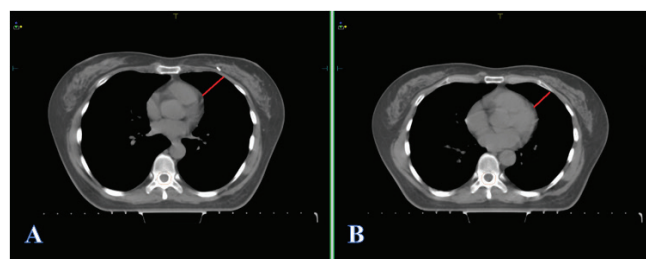


Figure 3 A) left: mDIBH / B) right: Free breathing. The CT scan (Figure A) shows a distance between the heart and the chest wall of 4.02 cm at mDIBH, while (Figure B) shows free breathing and a distance of 2.82 cm.

During treatment, the combination of ABC and Response gating interfaces ensures that the beam is only turned on during breath-holding, and that the beam is turned off when the patient is breathing freely. In this way, the patient does not receive any unexpected dose. The mDIBH process is repeated for each radiation field until the prescribed dose is delivered.

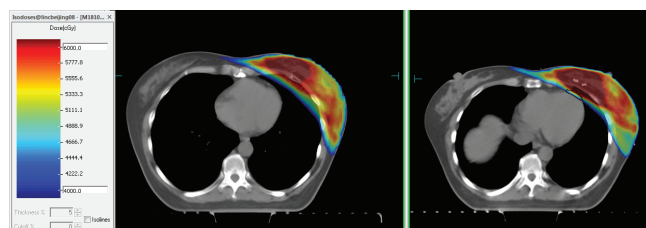


Figure 4 Presentation of the increase in the distance between the heart and the radiation field and the dose distribution in the application of the ABC system for performing the DIBH4 technique.

This technique has been shown not only to reduce the dose to the heart and left anterior descending artery (LAD) (Table 1). A potential benefit of the ABC device is its ability to reduce the variability associated with the setup procedure where errors can be reduced to less than 2 mm, and in some cases even 1 mm, both within a single fraction and between separate fractions (13,14).

Table 1 Comparison of lung volume and dose to healthy organs between mDIBH and free breathing (FB) plans.

OAR	Slobodno disanje (FB)	DIBH
Lung volume	1232.470 cc	2425.520 cc
Average dose to the heart	868.5 cGy	469.1 cGy
Heart V30	7.64%	0.3%
Heart max dose	5479 cGy	4209 cGy
Average dose to the lungs	1785.8 cGy	1430 cGy
Left lung V20	31%	25%
Left lung V30	26%	19%

Another method of performing the deep breath hold technique is vDIBH, where respiratory movement is monitored and the patient is instructed to hold their breath at specific points in the breathing cycle. The device for performing this technique is the RPM/ RGSC (real-time position control) system (Varian Medical Systems, Palo Alto, California, USA), where a surrogate device is placed on the patient’s chest and the vertical movement during the respiratory cycle provides data to create a trace of the patient’s breathing (Figure 5).

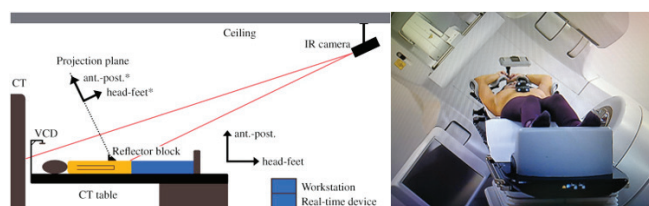


Figure 5 Illustration of the DIBH technique performed using the RGSC system (Varian). (Image available from the Science Direct website, article title: Performance evaluation and first clinical experience with the Varian RGSC module for breath detection of 15 lung cancer patients. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0939388918300643>)

During DIBH, the patient is asked to take a deep breath and hold his or her breath for an average of 25 seconds. When a CT scan is performed in preparation for treatment delivery, the patient lies on the CT table and a marker block is placed on the lower part of the chest, the movement of which is monitored using an infrared (IR) camera. The block’s movements are displayed on the monitor screen, which synchronizes and transmits the movements of the chest during the patient’s breathing. The system that helps the patient to more easily perform and monitor breathing during the preparation and implementation of this technique is known as the Visual Coaching Device (VCD). An optical camera with infrared rays records the feedback received from the marker block from the patient’s chest during treatment delivery. The device receives information about the patient’s breathing pattern, and the linear accelerator synchronously delivers the planned radiation dose at the moment when the camera registers that the patient’s chest is in the deep inspiration phase (Figure 6).

Conversely, when the patient is not in the deep inhalation and breath-hold phase, the camera will register chest movement beyond the planned limits, and the device will stop delivering the treatment.

Treatment is resumed only when the patient again achieves the deep inhalation and breath-hold phase, determined by the plan. With this technique, the patient is prepared and must voluntarily hold his breath.



Figure 6 Display of DIBH on the TrueBeam linear accelerator, the level of air in the lungs during free breathing, and by holding the breath in deep inspiration during the delivery of the radiation dose.

Also, one of the methods for conducting DIBH technique involves the use of surface-guided radiotherapy (SGRT) systems. The region of interest when using SGRT includes the breast and the surrounding area, i.e. only the chest. SGRT technique allows alignment of the ipsilateral arm and chin during free breathing (FB) before DIBH, minimizing breast deformation with partial irradiation and reproducing the position of the axillary and subclavian lymph nodes. Advances in SGRT eliminate the need for tattoos in conventional patient settings by using room lasers for patient alignment. Therefore, SGRT technique is increasingly used in DIBH radiotherapy for left breast cancer (15). Some of the systems used in SGRT are AlignRT (Vision RT Ltd., London, UK) and Sentinel, Catalyst (C-RAD, Uppsala, Sweden) which works by optically scanning the surface with LED lights and reprojecting captured by a CCD camera, which allows control of target position during placement and treatment (Figure 7.) (15).

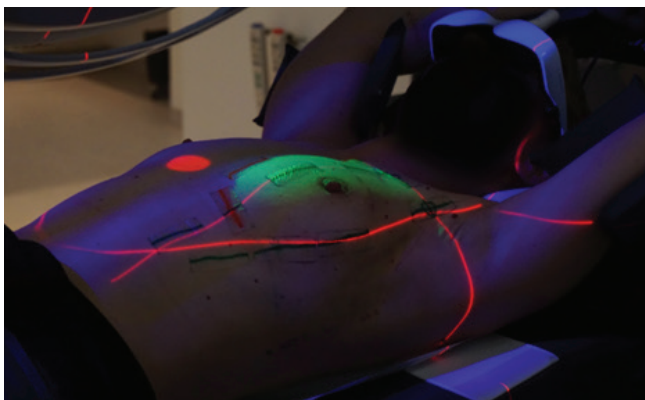


Figure 7 Patient treatment position: trigger point on the patient's sternum (red dot), treatment beam visualized by light (green), room lasers (red lines), catalyst scanning light (blue), and video goggles.

For DIBH treatment, at least two CT scans corresponding to free breathing and DIBH must be taken during the simulation. Patients are trained to breathe through the nose instead of the mouth. The patient contours on the two CT scans will be used to align the corresponding patient daily surfaces from the optical tracking system during treatment adjustments to ensure that patients achieve the same level of breath holding as during the simulation.

Clinical significance of the application of the DIBH technique

Since cardiac toxicity caused by radiotherapy has a prolonged latency period, there are no clinical data on the effects of DIBH on cardiac morbidity and mortality, and it is currently too early to say whether it effectively improves these outcomes. Despite this, many dedicated dosimetric comparisons have noted the benefits of DIBH, particularly with respect to cardiac dose parameters. DIBH is associated with significant improvements in both mean cardiac doses and mean LAD doses, with reductions of 25–67% and 20–73% when comparing the same patients planned with free breathing and DIBH (Table 1). Studies have observed perfusion defects in patients undergoing radiotherapy for left breast cancer, with defects correlating with the radiation fields used for treatment, and no perfusion defects have been found in patients treated with radiation fields that completely excluded the heart (16). The benefit of DIBH for cardiac radiation dose appears to extend to 3D and IMRT treatments and to those patients undergoing nodal and/or continuous (chest wall) radiation. As previously noted, patients with left-sided breast cancer appear to have an increased risk of cardiac mortality simply because of the proximity of the target to the heart, and it is likely that these patients would benefit most from DIBH (17). Patients with right-sided breast cancer may also benefit from DIBH, primarily because of the reduced ipsilateral and total lung radiation doses associated with DIBH in patients receiving IMC radiation. In addition, DIBH has been shown to significantly reduce cardiac radiation dose in women receiving nodal radiation to the IMC, primarily because of the increased cardiac radiation dose associated with IMC treatment compared with treatment of the breast and the tumor wall alone (18). The maximum distance to the heart, defined as the maximum distance within the radiation field between the leading edge of the cardiac contour and the trailing edge of the tangential field, correlates with the mean cardiac dose (19). Patients who have the greatest change in lung volume between DIBH and the free-breathing images tend to benefit most from DIBH in terms of cardiac dose. A more relaxed left breast could reduce the lower limit of the tangential fields and

thereby increase the radiation dose to the heart. Another consideration with DIBH is the variability in the position of organs and structures, both within and between treatments. The breast itself has been found to have both inter- and intracarcinoma reproducibility during DIBH treatment, with minimal shifts in alignment with bony anatomy (20).

AIM

The aim of this study was to show the real importance of the DIBH admission technique for the purpose of sparing organs at risk, primarily in the treatment of the left breast.

MATERIALS AND METHODS

This paper used qualitative research methods with a focus on systematic literature analysis. Data collection was carried out by reviewing available scientific and professional papers related to the application of the DIBH radiation technique in breast cancer. The research was conducted by analyzing studies and publications published in the period from 2016 to 2025. The content analysis method was used to process the collected sources. This method involves thematic grouping of information, identification of key concepts and technological solutions. The method of systematic literature review enabled a structured collection and selection of relevant publications from international databases such as PubMed, ScienceDirect, Scopus, Google Scholar and Web of Science. All publications used were originally published in English. The keywords used for the collection and selection of papers were: breast Ca radiotherapy, DIBH, ABC, RGSC, SGRT, toxic effects of RT on the heart and lungs.

Research results – review article

Author/Year/Reference	Name of the study	Type of the study	Objectives	Materials and methods	Results	Conclusion
Bergom C, Currey A, Desai N, Tai A, Strauss JB. 2018. (21)	Deep inspiration Breath Hold: Techniques and Advantages for Cardiac Sparing During Breast Cancer irradiation	Systematic review article	The aim of this systematic review was to outline several methods used to deliver treatment with DIBH, quantify the advantages of DIBH treatment, evaluate patient selection and identify challenges associated with DIBH techniques.	A review of the scientific literature describes different methods of performing the DIBH technique. Methods with ABC and RPM systems, as well as SGRT systems for surface patient monitoring, are described. Relevant dose metrics for the target volume and OAR in the application of the DIBH technique and patient breathing patterns are analyzed.	DIBH is associated with significant reductions in mean doses to the heart and LAD, with reductions of 25–67% and 20–73% when comparing the same patients who underwent both free breathing and DIBH. The patients with right breast cancer may also benefit from DIBH, mainly due to reduced ipsilateral and total doses to the lung in patients receiving IMC radiation. DIBH has also been shown to significantly reduce the dose to the heart in patients with nodal irradiation to the IMC, mainly due to the increased dose to the heart associated with IMC treatment compared with breast and chest wall treatment alone.	Radiotherapy for breast cancer has been shown to improve both local control and overall survival in patients; Improvements and advances in radiation technology and the application of the DIBH technique have yielded significant results in sparing the heart and reducing the mean radiation dose to the heart. DIBH has been shown to reduce radiation dose to the lungs.
Kuo CC, Chang CC, Cheng HW, Tsai JT. 2020. (17)	Impact of Active Breathing Control-Deep Inspiration Breath Hold (ABC-DIBH) on the dose to surrounding normal structures in tangential field left breast radiotherapy	Retrospective study	The aim of the study is to evaluate the organ-sparing potential of deep inspiration breath hold (DIBH) technique by comparing with the treatment plans among different respiratory phases based on the images retrieved from deep breathing 4D-CT.	This retrospective study included 14 patients with left-sided breast cancer who received adjuvant radiotherapy after BCS. Two sets of CT scans were performed, including 3D-CT images of DIBH with the active breathing control (ABC) device, and deep breathing 4D-CT images. Tangential angle IMRT plans with 4 portals were used for treatment planning. Three plans were generated for each patient. One plan was based on the 3D-CT images of DIBH, and the others were based on the 4D-CT images of middle of lung expansion (MLE) and start of lung expansion (SLE).	The mean heart dose was 4.01 Gy in SLE, 3.76 Gy in MLE, and 2.72 Gy in DIBH (P<0.001). The plans with DIBH showed significantly lower dose for the heart, left ventricle (LV), left anterior descending coronary artery (LAD), and left lung when compared with the plans of either MLE or SLE images (P<0.05). There was no significant difference in right lung mean dose and V5 right lung (P>0.05).	For the adjuvant treatment of breast cancer, the use of DIBH technique resulted in a significant dose reduction in heart, LV, LAD, and left lung, especially with enough deep inhalation. Hence, the DIBH technique could be considered as a promising tool for normal organ sparing.

<p>Testolin A, Ciccarelli S, Vidano G, Avitabile R, Dusi F, Alongi F. 2019. (22)target coverage and treatment compliance in left-sided breast cancer patients (LS-BCP</p>	<p>Deep inspiration breath-hold intensity modulated radiation therapy in a large clinical series of 239 left sided breast cancer patients: a dosimetric analysis of organs at risk doses and clinical feasibility from a single center experience</p>	<p>Retro-spective clinical research</p>	<p>To evaluate dose to organs at risk, target coverage and treatment compliance in left-sided breast cancer patients (LSBCP) treated with deep inspiration breath-hold (DIBH) and intensity modulated radiation therapy (IMRT) technique in a contest of daily clinical practice.</p>	<p>A total of 280 consecutive LSBCP referred for adjuvant radiotherapy were systematically screened for suitability of DIBH technique. 239 were able to comply with the requirement for DIBH. Relevant dose metrics for heart, left anterior descending (LAD) coronary artery, lungs, contralateral breast and planning target volume were retrospectively analyzed.</p>	<p>The average mean heart dose (MHD) for all patients was 0.94 Gy and mean maximum LAD dose was 13.82 Gy. MHD and LAD maximum dose were significantly higher in patients treated with conventional fractionation. In 57 patients (23.8%) the maximum LAD dose was >20 Gy. Mean V20 ipsilateral lung dose was 8.5%. Mean doses of contralateral breast and lung were 0.13 Gy and 0.09 Gy, respectively. Mean planning target volume V95% coverage was 96.1%. Compliance rate of DIBH technique was 84.5% (239/280).</p>	<p>DIBH and IMRT in daily clinical practice are feasible in high percentage of unselected patients and allows low levels of irradiation of organs at risk without compromising target coverage. However, despite low MHD a significant proportion of patients receives a maximum LAD dose superior to 20 Gy.</p>
<p>Dumane VA, Saksornchai K, Zhou Y, Hong L, Powell S, Ho AY. 2018. (8)</p>	<p>Reduction in low-dose to normal tissue with the addition of deep inspiration breath hold (DIBH) to volumetric modulated arc therapy (VMAT) in breast cancer patients with implant reconstruction receiving regional nodal irradiation</p>	<p>Clinical prospective study</p>	<p>goal was to report dosimetric effects of adding deep inspiration breath hold (DIBH) to VMAT in leftsided breast cancer patients with tissue expander (TE)/permanent implant (PI) reconstruction receiving RNI.</p>	<p>Ten consecutive breast cancer patients with unilateral or bilateral TE/PI reconstruction who were treated with a combination of VMAT and DIBH to the left reconstructed chest wall and regional nodes were prospectively identified. Free breathing (FB) and DIBH CT scans were acquired for each patient. VMAT plans for the same arc geometry were compared for FB versus DIBH.</p>	<p>The mean dose to the heart reduced on average by 2.9 Gy (8.2 to 5.3 Gy), with the addition of DIBH ($p < 0.05$). The max. dose to the left anterior descending (LAD) artery was reduced by 9.9 Gy, which related closely to the reduction in the max. heart dose (9.4 Gy). V05 Gy to the heart, ipsilateral lung, contralateral lung and total lung decreased on average by 29.6%, 5.8%, 15.4% and 10.8% respectively. V04 Gy and V03 Gy of the contralateral breast/ implant were respectively reduced by 13.2% and 18.3% using DIBH.</p>	<p>Combination of VMAT and DIBH showed significant dosimetric gains for low dose to the heart, lungs and contralateral breast/implant. Not surprisingly, the mean and maximum dose to the heart and to the LAD were also reduced. DIBH should be considered with the use of VMAT in breast cancer patients with implant reconstructions receiving RNI.</p>
<p>Sakyanun P, Saksornchai K, Nantavithya C, Chakkabat C, Shotelersuk K. 2020. (5)</p>	<p>The effect of deep inspiration breath-hold technique on left anterior descending coronary artery and heart dose in left breast irradiation</p>	<p>Clinical prospective research</p>	<p>The aim of study is to determine the effect of the deep inspiration breath-hold (DIBH) technique on left anterior descending coronary artery (LAD) region and heart dose in left breast cancer irradiation.</p>	<p>Twenty-five left breast cancer patients who previously received breast-conserving surgery underwent CT simulation with both free-breathing (FB) and DIBH techniques and four radiation treatment plans. The plan comprised the following with both the FB and DIBH techniques: whole breast (WB), and WB with internal mammary lymph nodes (WB+IMNs). The doses to the LAD region, heart and lungs were compared. Moreover, in-field maximum heart distance (maxHD) and breast volume were analyzed for correlations with the mean heart dose (MHD).</p>	<p>In the WB plan with DIBH vs. FB techniques, the mean radiation doses to the LAD region, MHD, and the left lung V20 were 11.48 Gy vs. 19.84 Gy, 2.95 Gy vs. 5.38 Gy, and 19.72% vs. 22.73%, respectively. In the WB+IMNs plan, the corresponding values were 23.88 Gy vs. 31.98 Gy, 6.43 Gy vs. 10.24 Gy, and 29.31% vs. 32.1%, respectively. MHD correlated with maxHD ($r = 0.925$) and breast volume ($r = 0.6$).</p>	<p>The use of the DIBH technique in left breast cancer irradiation effectively reduces the radiation doses to the LAD region, heart and lungs. MHD is associated with maxHD and breast size.</p>

<p>Islam MK, Islam MdS, Quddus AHMR, Naen MZ, Kumar N, Sultana N. 2024. (23)</p>	<p>Evaluation and Improving Treatment Plans of Gated Radiotherapy in Left-Sided Breast Cancer</p> <p>Patients Using Respiratory Motion Management System for Deep Inspiration Breath-Hold (DIBH)</p>	<p>Clinical prospective research</p>	<p>This study aimed to assess the use of the Varian Respiratory Motion Management System (RGSC) for radiation application in DIBH, with a focus on dosimetric plan comparison and treatment planning during free breathing (FB) and DIBH.</p>	<p>This prospective clinical trial comprised 100 patients with left-sided breast cancer who had undergone breast-conserving surgery.</p> <p>Gating control and the RGS system were employed for therapy application. Analytical anisotropic algorithm (AAA) was used to generate dual treatment plans after CT data were obtained in FB and DIBH. Using the Dose Volume Histogram (DVH), dosimetric output parameters of organs at risk were compared.</p>	<p>After each patient underwent dual treatment planning, 50 patients received treatment in Intensity Modulated Radiotherapy (IMRT) using DIBH, while 50 more patients received treatment in IMRT using Free Breath (FB). The mean cardiac dose reduction for DIBH in these patients was 7.23 to 3.41 Gy when compared to FB.</p>	<p>The current data demonstrate that RT could greatly lower mean doses to the heart and high-dose locations by implementing the DIBH approach.</p>
<p>Schönecker S, Walter F, Freislederer P, Marisch C, Scheithauer H, Harbeck N, et al. 2016. (15)</p>	<p>Treatment planning and evaluation of gated radiotherapy in left-sided breast cancer patients using the CatalystTM/Sentinel TM system for deep inspiration breath-hold (DIBH)</p>	<p>Clinical prospective trial</p>	<p>The aim of the present study was to evaluate the application of radiotherapy in DIBH using the CatalystTM/SentinelTM system, with a special emphasis on treatment planning and dosimetric plan comparison in free breathing (FB) and DIBH.</p>	<p>A total of 13 patients with left-sided breast cancer following breast conserving surgery were included in this prospective clinical trial. For treatment application the CatalystTM/SentinelTM system (C-RAD) was used. CT and surface data were acquired in FB and DIBH and dual treatment plans were created using Pencil Beam and Collapsed Cone Convolution. Dosimetric output parameters of organs at risk were compared using Wilcoxon signed-rank test.</p>	<p>Following dual treatment planning for all patients, nine of 13 patients were treated in DIBH. The reduction of the mean heart dose for DIBH compared to FB was 52 % (2.73 to 1.31 Gy). The maximum doses to the heart and LAD were reduced by 59 % (47.90 to 19.74 Gy) and 75 % (38.55 to 9.66 Gy), respectively. In six of the nine patients the heart completely moved out of the treatment field by DIBH.</p>	<p>The CatalystTM/SentinelTM system enabled a fast and reliable application and surveillance of DIBH in daily clinical routine. Furthermore, the present data show that using the DIBH technique during RT could significantly reduce high dose areas and mean doses to the heart.</p>
<p>Li Z, Jian C, Li Y, Pan Z, Yang G, Sun X. 2024. (24)</p>	<p>Clinical benefits of deep inspiration breath hold in postoperative radiotherapy for right sided breast cancer: a meta-analysis</p>	<p>Systematic review, a meta-analysis</p>	<p>The study aims to emphasize the clinical importance of the DIBH technique by quantifying its dosimetric advantages over FB in reducing radiation exposure to the heart, liver, and lungs for right-sided breast cancer patients.</p>	<p>A systematic retrieval of controlled trials comparing DIBH and FB techniques in postoperative radiotherapy for right-sided breast cancer was conducted utilizing the PubMed, Embase, Cochrane Library, and Web of Science databases. The primary outcomes assessed included the doses of adjacent normal tissues (heart, liver, and lungs). Summary standardized mean differences (SMD) along with 95% confidence intervals (CI) were computed, respectively.</p>	<p>The study encompassed an analysis of 313 patients derived from seven online studies, comprising 168 individuals in the DIBH group and 269 individuals in the FB group. The findings indicated that the DIBH group received significantly lower irradiation doses to the heart, liver, and lungs in comparison to the FB group, with statistical significance (heart dose: SMD = -0.63, 95% CI -0.85 to -0.41; liver dose: SMD = -1.15, 95% CI -1.91 to -0.38; lung dose: SMD = -0.79, 95% CI -1.23 to -0.35).</p>	<p>This meta-analysis indicated that the application of DIBH during postoperative radiotherapy for right sided breast cancer markedly decreases radiation exposure to the heart, liver, and lungs, while maintaining consistent tumor dose coverage.</p>

DISCUSSION

This paper collected and analyzed a total of eight studies and scientific literature articles that demonstrate the importance of using the DIBH radiotherapy technique in the treatment of breast cancer, with a special emphasis on the treatment of left breast cancer. Special attention was paid to the description and presentation of the toxic effects of radiotherapy on organs at risk, such as primarily the lungs and heart.

Various technological solutions can be used to perform the DIBH radiation technique, which provide good clinical and dosimetric treatment results. The results of a study by Bergom C, et al. (21), published in 2018, indicate the advantages of using the DIBH technique using the ABC or RPM system, or SGRT. The studies showed high accuracy of patient adjustment using optical surface imaging. A significant reduction in average doses to the heart and LAD was observed, with a reduction of 25–67% and 20-73% in comparison with patients in whom both free breathing and DIBH were planned. Studies have shown that patients with Ca of the right breast may benefit from DIBH due to reduced ipsilateral and total lung doses in patients who irradiate the breast only, and patients who irradiate the breast with a region of lymphatic drainage.

The results of the study by Kuo CC, et al. (17), point out that in the treatment of left breast cancer, the use of the DIBH technique resulted in a significant reduction of the dose to the heart, left ventricle, LAD and left lung. Where mean heart dose was 4.01 Gy in SLE, 3.76 Gy in MLE and 2.72 Gy in DIBH ($P < 0.001$).

Also, studies by Dumane VA, et al. and Testolin A, et al. (8,22) particularly emphasize the effect of using DIBH with IMRT and VMAT radiation technique in left breast cancer. The mean mean dose to the heart and maximum dose to the left anterior descending coronary artery (LAD) were significantly higher in patients treated with conventional fractionation. Besides that. A significant contribution was observed with the use of DIBH and VMAT in breast cancer patients with implant and tissue expander reconstructions.

Study by Sakyanun P, et al. (5) indicates significant advantages of left breast irradiation with DIBH compared to FB techniques, mean radiation doses in LAD region, mean dose to heart and left lung were 11.48 Gy compared to 19.84 Gy, 2.95 Gy compared to 5.38 Gy and 19.72% compared to 22.73%, respectively. Also, significant advantages were highlighted in the treatment of the breast with involved mammary lymph nodes. The mean heart dose was correlated with the maximum heart distance in the field ($r = 0.925$) and breast volume ($r=0.6$). Likewise, the results of the study by Ismam et al. (23), indicated a reduction in mean heart dose for DIBH of 7.23 to 3.41 Gy compared with FB. The dose reduction to organs at risk was shown in the results of a study (25), where the mean dose reduction to the heart for DIBH compared to FB was 2.73 to 1.31 Gy. The maximum doses to the heart and LAD were reduced by 59% and 75%, respectively.

A multi-institutional study comparing FB to DIBH showed that FB resulted in higher cardiac irradiation even when combined with IMRT. Similarly, a comparison of prone position versus DIBH in the supine position showed lower MHD and heart V30 with DIBH. These data suggest that DIBH more effectively increases the heart-BCW distance, thereby decreasing dose from internal scatter compared with other techniques such as heart blocks, IMRT segmentation, and prone positioning (20). The effectiveness of the DIBH technique can be seen in the treatment of the right breast. In support of this, the results of the study by Li Z, et al. (24) were cited, emphasizing a significant reduction in radiation exposure to the heart, liver and lungs, while maintaining consistent tumor radiation dose coverage.

CONCLUSION

The use of DIBH for the treatment of left side breast cancer can reduce the dose to the heart and lung, thereby reducing cardiac toxicity and the risk of medium- and long-term radiation-related complications. Various technological solutions can ensure the successful implementation of the DIBH technique, with a comfortable approach to performing this technique and good clinical outcomes. The DIBH radiation technique has found its effective application primarily in the treatment of the left breast, but it has

shown exceptional results in the treatment of cancer of the right breast and lung. The DIBH shows a dominant benefit in terms of OAR sparing, even in the comparison when using free breathing with IMRT technique or in the prone patient position.

REFERENCES

1. Ebcctg (Early Breast Cancer Trialists' Collaborative Group). Effect of radiotherapy after mastectomy and axillary surgery on 10-year recurrence and 20-year breast cancer mortality: meta-analysis of individual patient data for 8135 women in 22 randomised trials. *The Lancet*. 2014; 383(9935):2127-35. doi: 10.1016/S0140-6736(14)60488-8.
2. Henson KE, McGale P, Taylor C, Darby SC. Radiation-related mortality from heart disease and lung cancer more than 20 years after radiotherapy for breast cancer. *Br J Cancer*. 2013 ;108(1):179-82. doi: 10.1038/bjc.2012.575.
3. Darby SC, Ewertz M, McGale P, Bennet AM, Blom-Goldman U, Brønnum D, et al. Risk of Ischemic Heart Disease in Women after Radiotherapy for Breast Cancer. *N Engl J Med*. 2013;368(11):987-98. doi/10.1056/NEJMoa1209825
4. Poortmans PM, Collette S, Kirkove C, Van Limbergen E, Budach V, Struikmans H, et al. Internal Mammary and Medial Supraclavicular Irradiation in Breast Cancer. *N Engl J Med*. 2015; 373(4):317-27. doi/10.1056/NEJMoa1415369
5. Sakyanun P, Saksornchai K, Nantavithya C, Chakkabat C, Shotelersuk K. The effect of deep inspiration breath-hold technique on left anterior descending coronary artery and heart dose in left breast irradiation. *Radiat Oncol J*. 2020; 38(3):181-8. doi:10.3857/roj.2020.00094
6. Formenti SC, DeWyngaert JK, Jozsef G, Goldberg JD. Prone vs Supine Positioning for Breast Cancer Radiotherapy. *JAMA*. 2012; 308(9):861. doi:10.1001/2012.jama.10759
7. Lohr F, El-Haddad M, Dobler B, Grau R, Wertz HJ, Kraus-Tiefenbacher U, et al. Potential Effect of Robust and Simple IMRT Approach for Left-Sided Breast Cancer on Cardiac Mortality. *Int J Radiat Oncol*. 2009;74(1):73-80. doi: 10.1016/j.ijrobp.2008.07.018
8. Dumane VA, Saksornchai K, Zhou Y, Hong L, Powell S, Ho AY. Reduction in low-dose to normal tissue with the addition of deep inspiration breath hold (DIBH) to volumetric modulated arc therapy (VMAT) in breast cancer patients with implant reconstruction receiving regional nodal irradiation. *Radiat Oncol*. 2018; 13(1):187. doi:10.1186/s13014-018-1132-9
9. Dell'Oro M, Giles E, Sharkey A, Borg M, Connell C, Bezak E. A Retrospective Dosimetric Study of Radiotherapy Patients with Left-Sided Breast Cancer; Patient Selection Criteria for Deep Inspiration Breath Hold Technique. *Cancers*. 2019; 11(2):259. doi: 10.3390/cancers11020259
10. Partridge M, Tree A, Brock J, McNair H, Fernandez E, Panakis N, et al. Improvement in tumour control probability with active breathing control and dose escalation: A modelling study. *Radiat Oncol*. 2009; 91(3):325-9. doi: 10.1016/j.radonc.2009.03.017
11. Glide-Hurst CK, Gopan E, Hugo GD. Anatomic and Pathologic Variability During Radiotherapy for a Hybrid Active Breath-Hold Gating Technique. *Int J Radiat Oncol*. 2010; 77(3):910-7. doi:10.1016/j.ijrobp.2009.09.080
12. Wong JW, Sharpe MB, Jaffray DA, Kini VR, Robertson JM, Stromberg JS, et al. The use of active breathing control (ABC) to reduce margin for breathing motion. *Int J Radiat Oncol*. 1999; 44(4):911-9. doi: 10.1016/s0360-3016(99)00056-5
13. Remouchamps VM, Letts N, Vicini FA, Sharpe MB, Kestin LL, Chen PY, et al. Initial clinical experience with moderate deep-inspiration breath hold using an active breathing control device in the treatment of patients with left-sided breast cancer using external beam radiation therapy. *Int J Radiat Oncol*. 2003; 56(3):704-15. doi: 10.1016/S0360-3016(03)00010-5
14. Remouchamps VM, Vicini FA, Sharpe MB, Kestin LL, Martinez AA, Wong JW. Significant reductions in heart and lung doses using deep inspiration breath hold with active breathing control and intensity-modulated radiation therapy for patients treated

- with locoregional breast irradiation. *Int J Radiat Oncol.* 2003; 55(2):392-406. doi: 10.1016/s0360-3016(02)04143-3
15. Schönecker S, Walter F, Freislederer P, Marisch C, Scheithauer H, Harbeck N, et al. Treatment planning and evaluation of gated radiotherapy in left-sided breast cancer patients using the CatalystTM/SentinelTM system for deep inspiration breath-hold (DIBH). *Radiat Oncol.* 2016; 11(1):143. doi:10.1186/s13014-016-0716-5
 16. Zagar TM, Kaidar-Person O, Tang X, Jones EE, Matney J, Das SK, et al. Utility of Deep Inspiration Breath Hold for Left-Sided Breast Radiation Therapy in Preventing Early Cardiac Perfusion Defects: A Prospective Study. *Int J Radiat Oncol.* 2017; 97(5):903-9. doi: 10.1016/j.ijrobp.2016.12.017
 17. Kuo CC, Chang CC, Cheng HW, Tsai JT. Impact of Active Breathing Control-Deep Inspiration Breath Hold (ABC-DIBH) on the dose to surrounding normal structures in tangential field left breast radiotherapy. *Ther Radiol Oncol.* 2020 Dec [cited 2025 Aug 3];4:26-26. Available from: <http://tro.amegroups.com/article/view/6449/html>
 18. Mohamad O, Shiao J, Zhao B, Roach K, Ramirez E, Vo DT, et al. Deep inspiration breathhold for left-sided breast cancer patients with unfavorable cardiac anatomy requiring internal mammary nodal irradiation. *Pract Radiat Oncol.* 2017; 7(6): e361-7. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1879850017301121>
 19. Rochet N, Drake JI, Harrington K, Wolfgang JA, Napolitano B, Sadek BT, et al. Deep inspiration breath-hold technique in left-sided breast cancer radiation therapy: Evaluating cardiac contact distance as a predictor of cardiac exposure for patient selection. *Pract Radiat Oncol.* 2015; 5(3):e127-34. doi: 10.1016/j.prro.2014.08.003
 20. Tanguturi SK, Lyatskaya Y, Chen Y, Catalano PJ, Chen MH, Yeo WP, et al. Prospective assessment of deep inspiration breath-hold using 3-dimensional surface tracking for irradiation of left-sided breast cancer. *Pract Radiat Oncol.* 2015; 5(6):358-65. doi: 10.1016/j.prro.2015.06.002
 21. Bergom C, Currey A, Desai N, Tai A, Strauss JB. Deep Inspiration Breath Hold: Techniques and Advantages for Cardiac Sparing During Breast Cancer Irradiation. *Front Oncol.* 2018; 8:87. doi: 10.3389/fonc.2018.00087
 22. Testolin A, Ciccarelli S, Vidano G, Avitabile R, Dusi F, Alongi F. Deep inspiration breath-hold intensity modulated radiation therapy in a large clinical series of 239 left-sided breast cancer patients: a dosimetric analysis of organs at risk doses and clinical feasibility from a single center experience. *Br J Radiol.* 2019; 92(1101):20190150. doi:10.1259/bjr.20190150/7449374
 23. Islam MK, Islam MdS, Quddus AHMR, Naen MZ, Kumar N, Sultana N. Evaluation and Improving Treatment Plans of Gated Radiotherapy in Left-Sided Breast Cancer Patients Using Respiratory Motion Management System for Deep Inspiration Breath-Hold (DIBH). *Eur J Med Health Sci.* 2024;6(5):69-77. doi: 10.24018/ejmed.2024.6.5.2198
 24. Li Z, Jian C, Li Y, Pan Z, Yang G, Sun X. Clinical benefits of deep inspiration breath-hold in postoperative radiotherapy for right-sided breast cancer: a meta-analysis. *BMC Cancer.* 2024; 24(1):1238. doi:10.1186/s12885-024-12992-2
 25. Schönecker S, Walter F, Freislederer P, Marisch C, Scheithauer H, Harbeck N, et al. Treatment planning and evaluation of gated radiotherapy in left-sided breast cancer patients using the CatalystTM/SentinelTM system for deep inspiration breath-hold (DIBH). *Radiat Oncol.* 2016;11(1):143. doi: 10.1186/s13014-016-0716-5
- Authors' Contributions:** ET, NS, VS, MR-B, AD and BM contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
- Financial Support and Sponsorship:** nil.
- Conflict of Interest:** there are no conflicts of interest.

Health Risks of Genetically Modified Food

Zdravstveni rizici genetski modificirane hrane

Melda Pirić^{1*}, Aida Ahmed¹, Senada Džebo², Samela Zelić³, Merima Ligata⁴, Franka Matic⁵

¹Clinic of Nephrology and Renal Replacement Therapy, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia i Hercegovina

²Head Nurse, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosna i Hercegovina

³Clinic of Emergency Medicine, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia i Hercegovina

⁴Faculty of Health Studies, University of Sarajevo, Stjepana Tomića 1, 71000 Sarajevo, Bosnia i Hercegovina

⁵Ministry of Health and Social Policy of the Central Bosnia Canton, Stanična br.43, 72207 Travnik, Bosnia i Hercegovina

***Corresponding author:** Melda Pirić, Clinic of Nephrology and Renal Replacement Therapy, Clinical Center University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia i Hercegovina, Email: piricmelda@gmail.com

ABSTRACT

Introduction: the growth of the world population and the global food crisis are increasing the pressure on agriculture, and genetically modified (GM) crops offer a potential solution due to their increased resistance to diseases and better adaptation to stresses. GM foods are created by changing genetic material to achieve desired traits, but there are concerns about their safety.

Aim: to outline the potential health risks of GM foods, such as allergenicity, toxicity, antibiotic resistance and carcinogenicity.

Materials and methods: the work was conducted by reviewing the scientific literature published in available relevant databases. Data published in official reports of leading authorities in the field of food safety were used, the results of which were processed using a descriptive method.

Results: the research shows that most legally approved GM products are not associated with immediate adverse health effects, but some studies indicate the need for further monitoring and research.

The example of GM soy with Brazil nut protein has shown the potential for allergic reactions, which has led to stricter safety protocols. The toxicity of GM foods has not been proven compared to conventional plants, and the risk of horizontal transfer of antibiotic resistance genes is considered very low with strict regulations. Research to date has not linked GM foods to an increased risk of carcinogenicity, but continued monitoring is recommended.

Conclusion: approved GM crops are generally safe for human consumption, but due to the complexity of biological systems and potential long-term effects, it is necessary to continue detailed research and monitoring of GM food safety. Strict legal frameworks and advanced technologies significantly contribute to risk reduction.

Keywords: GM food, allergenicity, toxicity, consumer health

SAŽETAK

Uvod: porast svjetske populacije i globalna prehrambena kriza povećavaju pritisak na poljoprivredu, a genetski modificirani (GM) usjevi nude potencijalno rješenje zahvaljujući većoj otpornosti na bolesti i boljoj prilagodbi stresovima. GM hrana nastaje promjenom genetskog materijala radi postizanja željenih osobina, no postoje zabrinutosti vezane uz njenu sigurnost.

Cilj: prikazati potencijalne zdravstvene rizike GM hrane, kao što su alergičnost, toksičnost, rezistencija na antibiotik i kancerogenost.

Materijali i metode: rad je urađen pregledom naučne literature publikovane u dostupnim relevantnim bazama podataka. Koristili su se podaci objavljeni u službenim izvještajima vodećih autoriteta u polju sigurnosti hrane, čiji su rezultati obrađeni deskriptivnom metodom.

Rezultati: istraživanja pokazuju da većina zakonski odobrenih GM proizvoda nije povezana s neposrednim štetnim učincima na zdravlje, no pojedine studije ukazuju na potrebu za daljnjim praćenjem i istraživanjima. Primjer GM soje s proteinom brazilskog oraha pokazao je potencijal za alergijske reakcije, što je dovelo do pooštavanja sigurnosnih protokola. Toksičnost GM hrane nije dokazana u usporedbi s konvencionalnim biljkama, a rizik od horizontalnog prijenosa gena za rezistenciju na antibiotike smatra se vrlo niskim uz stroge regulative. Dosadašnja istraživanja nisu povezala GM hranu s povećanim rizikom od kancerogenosti, ali se preporučuje kontinuirano praćenje.

Zaključak: odobreni GM usjevi su općenito sigurni za ljudsku prehranu, ali zbog kompleksnosti bioloških sistema i potencijalnih dugoročnih efekata neophodno je nastaviti detaljna istraživanja i praćenje sigurnosti GM hrane. Striktni zakonski okviri i napredne tehnologije značajno doprinose smanjenju rizika.

Ključne riječi: GM hrana, alergičnost, toksičnost, zdravlje potrošača

INTRODUCTION

The increasing population is putting great pressure on the leading structures due to the global food crisis. Millions of people suffer from hunger and malnutrition, resulting in a loss of a large number of human lives every year. The fixed amount of arable land intended for agriculture, and climate change, are some of the factors that cause a decrease in crop yields intended for feeding the population. It is necessary to breed plants that have the ability to withstand biotic and abiotic stresses, which can be achieved using conventional breeding techniques, but it is a very time-consuming process. One way to circumvent all obstacles is to use genetically modified crops (1,2).

The advantages of growing GM (genetically modified) foods have encouraged producers to produce more crops, including greater resistance to disease, reduced exposure of agricultural workers to pesticides, improved taste and appearance of crops, and the ability to grow larger quantities of GM crops on the same arable land. This technology helps crops grow much taller and faster locally than native varieties, thereby helping to alleviate the global food crisis (3).

Genetically modified (GM) foods refer to foods derived from organisms whose genetic material has been altered using molecular biology techniques to achieve desirable traits, such as pest resistance, herbicide tolerance, or an improved nutritional profile. Since the 1990s, GM crops have become an increasingly important part of global agriculture, and the debate over their health effects remains intense (4,5).

Health risks associated with GM foods may include allergenic potential, toxic effects of novel proteins, horizontal gene transfer (particularly antibiotic resistance genes), and indirect risks related to changes in agricultural practices, such as increased use of herbicides. While many regulatory bodies, including EFSA, FDA, and WHO, consider approved GM crops safe for human consumption when assessed according to current standards, some scientific reviews continue to indicate a lack of long-term independent studies that would rule out any potential adverse effects (6,7).

AIM

The aim of the study was to present the potential health risks of GM foods, such as allergenicity, toxicity, antibiotic resistance and carcinogenicity

MATERIALS AND METHODS

The study was conducted by reviewing scientific literature published in relevant available databases. It also used data published in official reports of the leading authorities in the field of food safety, which results were processed using a descriptive method.

RESULTS

Genetically modified food potentially carries risks such as unforeseen allergic reactions, possible organ toxicity, development of resistance to antibiotics, and possible carcinogenic effects on the body. The results of conducted research on the health risks of genetically modified food show diverse findings, where most legally approved GM products are not associated with immediate harmful factors to human health, while some studies still point to potential long-term risks that require additional testing and monitoring (8).

Allergenicity

Assessing the allergenicity of GM food is a key aspect of its safety, since the introduction of new genes can potentially increase the allergic risk. A concrete example is the case of GM soybeans with an inserted gene for the protein 2S albumin from Brazil nut, which is a known allergenic protein. Research by Nordlee JA, et al. (1996) showed that people allergic to Brazil nuts can develop allergic reactions after consuming GM soybeans that contain this protein (9).

Due to these findings, the further development and commercialization of this GM soybean was stopped, which resulted in the tightening of safety evaluation procedures for GM foods. Today, the assessment of allergenicity is carried out multi-layered and includes computer gene analysis, laboratory tests

of protein stability in the digestive system and in certain cases, testing on sensitive categories before product approval. This example highlights the importance of a cautious approach to risk assessment to protect vulnerable populations and ensure the safety of GM foods. Most of the approved GM crops, such as corn, soybeans and rice, show a level of allergenicity comparable to conventional varieties, which is confirmed by recent reviews of the literature (10).

Toxicity of GM foods

The toxicity of genetically modified foods is one of the key issues in assessing their safety. Toxicity refers to the potential for new genetic materials or proteins expressed in GM crops to have adverse effects on human health. To investigate toxicity, a number of studies are conducted, including acute, subacute, and chronic studies in animal models, as well as toxicological analyses that include the evaluation of potential toxic substances, metabolites, and unexpected changes in the biochemical system of the plant (9,10).

The results of numerous systematic reviews and meta-analyses show that GM crops currently on the market do not exhibit a higher degree of toxicity compared to conventional plants. For example, a review of more than 80 toxicological studies over a period of several decades found no evidence of acute or subchronic toxic effects of GM foods. However, specific genetic modifications that target the production of new bioactive molecules or resistance to stresses require additional analysis to exclude potential unexpected effects, such as the creation of new toxins or the enhancement of existing ones (11).

Certainly, there are strict legal standards that require producers of GM crops to conduct extensive toxicological analyses before they are allowed to sale their products on the market. Also, post-marketing monitoring remains important to monitor for possible long-term effects that short-term studies may not have detected (12).

Resistance to antibiotics

One of the concerns about the safety of GM foods is the potential for the transfer of antibiotic resistance genes. In the process of creating GM plants, antibiotic resistance genes are often used as markers to select cells that have successfully integrated the desired gene. There is concern that these genes could be horizontally transferred to bacteria in the human or animal digestive system, potentially increasing antibiotic resistance, which is already a global public health problem (13).

Although laboratory studies have shown that such transfer is extremely rare and almost non-existent in the real digestive tract, regulatory agencies worldwide such as EFSA (European Food Safety Authority) and FDA (US Food and Drug Administration) require that new GM products avoid the use of antibiotic resistance genes, especially those used in human medicine (13,14).

The current trend in GM crop development is the use of alternative selection markers or techniques that remove marker genes from the final product. This significantly reduces the potential risk of resistance spreading. Follow-up studies and risk assessments continue to confirm that the presence of antibiotic resistance genes in approved GM crops is minimal and does not pose a significant risk to public health (13).

Carcinogenicity

Research on the carcinogenicity of genetically modified (GM) foods has so far not provided convincing evidence that consumption of GM crops increases the risk of developing cancer in humans. Most toxicological studies in animal models, which have included long-term chronic studies, have not shown an increased incidence of tumors after exposure to GM foods compared to conventional foods (14).

Literature and systematic reviews also confirm the lack of evidence of genotoxicity or carcinogenic potential of GM crops currently available on the market. Studies focusing on specific GMOs with

imported genes for insecticide production (e.g. Bt proteins) have not shown increased carcinogenicity in animals. However, given the complexity of cancer mechanisms and possible long-term effects, some authors emphasize the need for continued monitoring and additional long-term studies to exclude rare or cumulative effects (15).

Apparently, available data suggest that consumption of approved GM foods does not pose an increased risk of developing cancer compared to non-GM foods, but it is important to maintain caution and conduct further research (14,15).

The current scientific literature provides a significant amount of evidence that approved GM crops are as safe as their conventional counterparts, provided that each new genetic modification is evaluated individually and subjected to strict toxicological, allergic and molecular analyses (15).

DISCUSSION

The research results on the health risks of genetically modified (GM) foods indicate that most approved GM products are not associated with immediate adverse health effects, but continued assessment is needed due to possible long-term risks (16).

The assessment of allergenicity is crucial, because the introduction of foreign genes can increase the allergic risk. The example of GM soy with Brazil nut protein shows that it is possible to cause allergic reactions, which has led to stricter safety protocols. Most of today's GM crops have allergenicity comparable to conventional plants (17).

Regarding toxicity, systematic reviews show that GM plants do not cause greater toxicity compared to conventional crops. However, specific modifications require additional testing, and strict legal frameworks ensure safety (18).

Concerns about antibiotic resistance relate to the possibility of horizontal gene transfer from GM plants to bacteria. Although such transmission is rare, regulations require avoiding antibiotic-resistant genes and using safer methods (19).

CONCLUSION

Genetically modified foods have been very detailed safety assessed that have so far not shown significant health risks compared to conventional crops. However, due to the complexity of biological systems and possible long-term effects, continuous monitoring and additional research are necessary, especially in the areas of allergenicity, toxicity and antibiotic resistance. Strict legal frameworks and advanced technologies contribute to minimizing potential risks, thus ensuring the safety of GM foods for consumers.

REFERENCES

1. IPCC. Climate Change and Land: Summary for Policymakers. Intergovernmental Panel on Climate Change. (2019). <https://www.ipcc.ch/srcccl/chapter/chapter-5/>
2. Institute of Food Safety. Benefits of Genetically Modified Crops. 2023. <https://foodsafety.institute/food-biotechnology/benefits-of-genetically-modified-crops/>
3. Patrick A. Increasing Yield of Crops by Genetic Modifications. *Advan Genet Eng.* 2023;12(4)1.
4. Shen C, Yin X-C, Jiao B-Y, Li J, Jia P, Zhang X-W, et al. Evaluation of adverse effects/events of genetically modified food consumption: a systematic review of animal and human studies. *Environ Sci Eur.* 2022;34(8). doi.org/10.1186/s12302-021-00578-9
5. Nap JP, Metz PL, Escaler M, Conner AJ. The release of genetically modified crops into the environment. *Plant J.* 2003;33(1):1-18. doi:10.1046/j.1365-313X.2003.01606.x
6. Questions and Answers on Food Genetically Modified. World Health Organization. 2022. <https://www.who.int/news-room/questions-and-answers/item/food-genetically-modified>
7. World Economic Forum. Climate Change is Accelerating the Global Food Crisis. 2023. <https://www.weforum.org/stories/2023/07/climate-change-is-accelerating-the-global-food-crisis-we-must-act-now-to-protect-the-most-vulnerable/>
8. National Academies of Sciences, Engineering, and Medicine. Genetically Engineered Crops: Experiences and Prospects. Washington, DC: The National Academies Press; 2016. doi.org/10.17226/23395
9. Nordlee JA, Taylor SL, Townsend JA, Thomas LA, Bush RK. Identification of a Brazil-nut allergen in transgenic soybeans. *N Engl J Med.* 1996;334(11):688-92. doi:10.1056/NEJM199603143341102
10. Panchin AY, Tuzhikov AI. Published GMO studies find no evidence of harm when corrected for multiple comparisons. *Crit Rev Biotechnol.* 2017;37(2):213-7. doi:10.3109/07388551.2015.1130684.
11. Van Eenennaam AL, Young AE. Prevalence and impacts of genetically engineered feedstuffs on livestock populations. *J Anim Sci.* 2014;92(10):4255-78. doi:10.2527/jas.2014-8124
12. Kowalec M, Rauschen S, Schiemann J, Wilhelm R. Post-market environmental monitoring of genetically modified plants: Conclusions and recommendations from the EU Commission's working group. *J Verbraucherschutz Lebensmittelsicherh.* 2009;4(4):271-3. doi:10.1007/s00003-009-0547-5.
13. EFSA Panel on Genetically Modified Organisms (GMO). Guidance on allergenicity assessment of genetically modified plants. *EFSA Journal.* 2017;15(5):e04856. doi.org/10.2903/j.efsa.2017.4862.
14. Goodman RE, Vieths S, Sampson HA, Hill D, Ebisawa M. Allergenicity assessment of genetically modified crops - - What makes sense? *Nat Biotechnol.* 2008;26(1):73-81. doi: 10.1038/nbt1343.

15. Snell C, Bernheim A, Bergé JB, Kuntz M, Pascal G, Paris A, et al. Assessment of the health impact of GM plant diets in long-term and multigenerational animal feeding trials: A literature review. *Food Chem Toxicol.* 2012;50(3-4):1134-48. doi: 10.1016/j.fct.2011.11.048.
16. World Health Organization. Food, genetically modified. Geneva: WHO; 2014 [cited 2025 Sep 10]. Available from: <https://www.who.int/news-room/questions-and-answers/item/food-genetically-modified>
17. Su S, Ezhuthachan ID, Ponda P. Genetically modified foods and food allergy. *J Food Allergy.* 2020;2(2):111-4. doi:10.2500/jfa.2020.2.200012.
18. Turnbull C, Lillemo M, Hvoslef-Eide T. Global regulation of genetically modified crops amid the gene edited crop boom - a review. *Front Plant Sci.* 2021;12:630396. doi: 10.3389/fpls.2021.630396
19. EFSA Panel on Genetically Modified Organisms (GMO) & EFSA Panel on Biological Hazards (BIOHAZ). Scientific opinion on the use of antibiotic resistance genes as marker genes in genetically modified plants. *EFSA Journal.* 2009;7(6):1108. doi:10.2903/j.efsa.2009.110

Authors' Contributions: MP, AA, SDž, SZ, ML and FM contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Financial Support and Sponsorship: nil.

Conflict of Interest: there are no conflicts of interest.

Health Promotion as a Basis for the Prevention of Type 2 Diabetes

Promocija zdravlja kao temelj prevencije dijabetesa tipa 2

Ševala Mujović*

Faculty of Health Studies, University of Sarajevo, Stjepana Tomića 1, 71000 Sarajevo, Bosnia and Herzegovina

***Corresponding author:** Ševala Mujović, BA, Faculty of Health Studies, University of Sarajevo, Stjepana Tomića 1, 71000 Sarajevo, Bosnia and Herzegovina Email: sevala.mujovic@gmail.com

ABSTRACT

Introduction: health promotion is the basis of modern public health strategies aimed at the prevention of non-communicable diseases, including diabetes type 2 (DMT2). Given that DMT2 can be largely prevented by targeting modifying risk factors, promotional and educational interventions have become a key tool in primary prevention.

Aim: to investigate the impact of promotional and educational interventions aimed at adopting healthy lifestyle habits in the context of primary diabetes type 2 prevention.

Materials and methods: the paper was designed as a qualitative, non-experimental research based on a review of scientific and professional literature. Data were collected through electronic databases (PubMed, Google Scholar, Science Direct) and official sources such as the World Health Organization (WHO), the International Diabetes Federation (IDF), and the Institute of Public Health of the Federation of BiH.

Results: an analysis of several international and local studies established that promotional interventions focused on education about proper nutrition, physical activity, and body weight regulation significantly contributed to reducing risk factors for DMT2. Programs which included a family and school component were particularly effective. However, data from the Federation of BiH indicated a gap between strategic documents and their practical implementation, given

the continuous increase in the number of patients.

Conclusion: promotional and educational interventions have great potential in the prevention of T2DM, but their effectiveness depends on institutional support, intersectoral cooperation and active community involvement. Nurses are an important resource in the implementation of these measures.

Keywords: type 2 diabetes, health promotion, prevention, risk factors, healthy lifestyles, training, nurses

SAŽETAK

Uvod: promocija zdravlja predstavlja osnovu savremenih javnozdravstvenih strategija usmjerenih na prevenciju nezaraznih bolesti, uključujući dijabetes tipa 2 (DMT2). S obzirom na to da se DMT2 u velikoj mjeri može spriječiti djelovanjem na modificirajuće faktore rizika, promotivno-edukativne intervencije postaju ključan alat primarne prevencije.

Cilj: istražiti uticaj promotivno-edukativnih intervencija usmjerenih na usvajanje zdravih životnih navika u kontekstu primarne prevencije dijabetesa tipa 2.

Materijali i metode: rad je dizajniran kao kvalitativno, neeksperimentalno istraživanje koje se

temelji na pregledu naučne i stručne literature. Podaci su prikupljeni putem elektronskih baza (PubMed, Google Scholar, Science Direct) i službenih izvora poput Svjetske zdravstvene organizacije (WHO), Međunarodne federacije za dijabetes (IDF) i Zavoda za javno zdravstvo Federacije BiH.

Rezultati: analizom više međunarodnih i lokalnih istraživanja utvrđeno je da promotivne intervencije usmjerene na edukaciju o pravilnoj ishrani, fizičkoj aktivnosti i regulaciji tjelesne mase značajno doprinose smanjenju faktora rizika za DMT2. Posebno su efikasni programi koji uključuju porodičnu i školsku komponentu. Ipak, podaci iz Federacije BiH ukazuju na jaz između strateških dokumenata i njihove praktične primjene, s obzirom na kontinuirani porast broja oboljelih.

Zaključak: promotivno-edukativne intervencije imaju veliki potencijal u prevenciji DMT2, ali njihova efikasnost zavisi od institucionalne podrške, međusektorske saradnje i aktivnog uključivanja zajednice. Medicinske sestre predstavljaju važan resurs u implementaciji ovih mjera.

Ključne riječi: dijabetes tipa 2, promocija zdravlja, prevencija, rizični faktori, zdravi stilovi života, edukacija, medicinske sestre.

INTRODUCTION

Health promotion is a process enabling people to increase control over their health. It represents the foundation of a modern approach to preserving and improving the health of individuals and communities. Health promotion is not only about providing information, but also about encouraging individuals to recognize their own health needs and take responsible and active role in maintaining health through everyday habits (1). In order for the measures to be successful and sustainable, health promotion should involve individuals, families and communities. It is necessary to identify factors that influence health, develop effective promotion strategies, and ensure social justice and equal access. Health promotion is closely

related to disease prevention, but differs from it as it is focused on preserving and improving health, contrary to the main role of prevention to prevent the onset of disease or complications related to that disease (2).

Diabetes mellitus type 2 (DMT2) is a disease that is increasingly taking on the proportions of a global epidemic. Although it is a disease that develops gradually, often without expressing symptoms, it has serious consequences for the quality of life and functional ability of the individual. For this very reason, health promotion plays a crucial role in the DMT2 prevention. Risk factors for the T2DM development, such as unbalanced diet, physical inactivity, excess body weight and smoking can be recognized and corrected through targeted public health interventions. Nurses play an important role through interventions that help people develop the resources to maintain and improve their health. They fulfill their role as educators in nurseries, schools, communities, work environments, and healthcare institutions (3).

AIM

The aim of this paper was to investigate the impact of promotional and educational interventions aimed at adopting healthy lifestyle habits in the context of primary diabetes type 2 prevention.

MATERIALS AND METHODS

This professional paper was designed as a qualitative non-experimental research based on the relevant scientific literature review and focused on a qualitative approach, using a descriptive analysis methodology. Data were collected through electronic databases (PubMed, Google Scholar, Science Direct) and official sources such as the World Health Organization (WHO), the International Diabetes Federation (IDF), and the Institute of Public Health of the Federation of BiH.

RESULTS

Shakya P, et al. Nepal (2023) (4)	The importance of preventive programs in less developed countries was highlighted, along with increased education and removal of obstacles.
McAlpin N, et al. NY, SAD (2022) (5)	Adolescents suffer negative peer influence on nutrition, but positive influence on physical activity.
Rahim NE, et al. 44 države (2023) (6)	In low- and middle-income countries, a large number of individuals are at high risk of developing diabetes.
Venkatesh S, et al. SAD (2024) (7)	Education contributed to the adoption of proper eating habits, better cooking techniques and food selection.
Bekele H, et al. Afrika (2020) (8)	The main obstacles are: systemic (changes in population, poor access and low quality of health-care) and personal (poverty and costs, educational status and perception of illness).
Andreae SJ, et al. SAD (2024) (9)	The family has an important role in diabetes prevention, especially as a support in lifestyle changes.
Lambrinou CP, et al. Grčka (2020) (10)	Primary schools are key places for promoting healthy habits and preventing obesity as a key factor in the T2DM development.
Farhat G, et al. 3 države (2024) (11)	In the case of non-modifying factors, such as ethnic groups, prevention programs do not reduce the incidence of T2DM.

DISCUSSION

Health promotion is a key strategy in the prevention of type 2 diabetes, as this form of diabetes can largely be prevented or delayed by timely action on modifiable risk factors. The importance of education as a preventive method was indicated. Contrary to those

studies, it has been shown that lifestyle changes have no major effect on the DMT2 prevention in South Asians. The reason is that prevention programs cannot influence unmodified risk factors (Farhat G, et al.) (11). One of the key factors for the prevention of DMT2 is a change in eating habits. Venkatesh S, et al. (7) showed the implementation of a program that greatly influenced changes in eating habits by teaching participants how to prepare healthy meals and make the right choice of foods. The impact of risk factors is largely expressed among young people as they tend to experiment and follow trends, which greatly impairs their health (McAlpin N, et al.) (5). School is the best environment for the education of children and adolescents, with an emphasis on primary schools (Lambrinou CP, et al.) (10). The greatest risk of getting sick is observed in low- and middle-income countries, due to lack of adequate investments in prevention measures. Key obstacles in the implementation of prevention programs are the lack of resources (money, staff, motivation) and poor living conditions (poverty, low level of education, diseases).

CONCLUSION

Health promotion is a fundamental pillar in the prevention of type 2 diabetes (DMT2), especially in the context of the global disease growth, which affects all ages and social groups. Insight into relevant research and strategies, including documents from the Federation of Bosnia and Herzegovina, indicates that effective prevention requires a systemic approach which includes education, empowerment of individuals, changes in the living environment, and early identification of at-risk individuals. Despite the existence of strategic frameworks in the Federation of BiH, the actual effects on reducing the prevalence of DMT2 remain limited due to inadequate implementation, lack of evaluation and limited investment in human resources. Nurses are a key and underutilized resource in the promotion of healthy lifestyles and T2DM prevention. Their closeness to patients, accessibility in the community, and potential for education and counseling make them ideal actors in the implementation of preventive measures.

Through the empowerment and continuous education of nurses, it is possible to significantly increase the effectiveness of preventive interventions, especially in schools, workplaces, and primary health care. Only through the synergy of all sectors and the consistent application of modern public health principles it is possible to slow down or stop the growth of T2DM patients.

REFERENCES

- Pilav A. Sistemi zaštite zdravlja. Univerzitet u Sarajevu, Fakultet zdravstvenih studija; Sarajevo: 2014.
- Edelman C, Kudzma CE. Health Promotion Throughout the Lifespan. 10th ed. St. Louis: Elsevier Health Sciences; 2021.
- Dokić M, Jevtić M, Balać D. Prevencij diabetesa mellitusa tipa 2 kod dece i adolescenata. Medicinski glasnik Specijalne bolnice za bolesti štitne žlezde i bolesti metabolizma Zlatibor. 2011;16(41): 50- 65.
- Shakya P, Bajracharya M, Skovlund E, Shrestha A, Karmacharya BM, Kulseng BE, et al. How Did People with Prediabetes Who Attended the Diabetes Prevention Education Program (DiPEP) Experience Making Lifestyle Changes? A Qualitative Study in Nepal. *Int J Environ Res Public Health*. 2023;20(6):5054. doi: 10.3390/ijerph20065054.
- McAlpin N, Elaiho CR, Khan F, Cruceta C, Goytia C, Vangeepuram N. Use of Focus Groups to Inform a New Community-Based Youth Diabetes Prevention Program. *Int J Environ Res Public Health*. 2022;19(15):9655. doi: 10.3390/ijerph19159655.
- Rahim NE, Flood D, Marcus ME, Theilmann M, Aung TN, Agoudavi K, et al. Diabetes risk and provision of diabetes prevention activities in 44 low-income and middle-income countries: a cross-sectional analysis of nationally representative, individual-level survey data. *Lancet Glob Health*. 2023;11(10):1576-86. doi: 10.1016/S2214-109X(23)00348-0.
- Venkatesh S, Leal DO, Valdez A, Butler PI, Keenan OE, Montemayor-Gonzalez E. Cooking Well with Diabetes: A Healthy Cooking School for Diabetes Prevention and Management. *Nutrients*. 2024;16(15):2543. doi: 10.3390/nu16152543.
- Bekele H, Asefa A, Getachew B, Belete AM. Barriers and Strategies to Lifestyle and Dietary Pattern Interventions for Prevention and Management of TYPE-2 Diabetes in Africa, Systematic Review. *J Diabetes Res*. 2020;2020:7948712. doi: 10.1155/2020/7948712.
- Andreae SJ, Reeves H, Casey T, Lindberg A, Pickett KA. A systematic review of diabetes prevention programs adapted to include family members. *Prev Med Rep*. 2024;39:102655. doi: 10.1016/j.pmedr.2024.102655.
- Lambrinou CP, Androutsos O, Karaglani E, Cardon G, Huys N, Wikström K, et al. Effective strategies for childhood obesity prevention via school based, family involved interventions: a critical review for the development of the Feel4Diabetes study school based component. *BMC Endocr Disord*. 2020;20(Suppl 2):52. doi: 10.1186/s12902-020-0526-5.
- Farhat G, Mellor DD, Sattar N, Harvie M, Issa B, Rutter MK. Effectiveness of lifestyle interventions/culturally bespoke programmes in South Asian ethnic groups targeting weight loss for prevention and/or remission of type 2 diabetes: a systematic review and meta-analysis of intervention trials. *J Hum Nutr Diet*. 2024;37(2):550-63. doi: 10.1111/jhn.13279.

Declaration of patient consent: the author certifies that she obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal.

Authors' contributions: ŠM gave substantial contribution to the conception or design of the article and in the acquisition, analysis and interpretation of data for the work.

Financial support and sponsorship: nil.

Conflict of interest: there are no conflicts of interest.

Education as Prevention of Peristomal/Perifistular Complications: Moisture-Associated Skin Damage Around a Fistula - Case Report

Edukacija kao prevencija peristomalnih/perifistularnih komplikacija: Oštećenja kože oko fistule uzrokovano vlagom - prikaz slučaja

Elmedina Mrkulić*, Alma Hadžić, Elvira Kundo, Elvedina Hodžić

Pediatric Clinic, Clinical Center University of Sarajevo, Patriotske lige 81, 71000 Sarajevo, Bosnia and Herzegovina

*Corresponding author: Elmedina Mrkulić, Pediatric Clinic, Clinical Center University of Sarajevo, Patriotske lige 81, 71000 Sarajevo, Bosnia and Herzegovina, Email:elmamrkulic@gmail.com

ABSTRACT

Introduction: peristomal and perifistular complications, particularly moisture-associated skin damage (MASD), are common in patients with a stoma or fistula and can lead to pain, infection, and delayed wound healing. The main risk factors include improper application of the collection system and a lack of adequate education for healthcare staff and patients.

Case Report: this paper presents the case of a 17-year-old female patient with Crohn's disease who developed a spontaneous enterocutaneous fistula accompanied by severe skin damage due to improper use of the stoma system. Deficiencies identified in nursing practice the day after admission highlighted the need for additional education of nursing staff. The collection system was corrected, the skin was treated with protective pastes and barrier films, and air-drying techniques were implemented. Simultaneously, educational interventions were carried out for both the nursing staff and the patient, aiming to prevent further complications and achieve self-care competency.

Results: during hospitalization, careful daily care of the perifistular skin was provided. By the eighth day of treatment, epithelialization was achieved, significantly

reducing the risk of infection. By discharge, the patient was successfully trained for independent care of the fistula with ongoing supervision.

Conclusion: this case confirms that proper assessment, education, and an individualized approach to the patient are key factors in the successful management of complications related to stomas and fistulas. Education of nurses and patients should be an integral part of daily clinical practice, regardless of the level of the healthcare institution.

Keywords: fistula, skin damage, education, stoma care, adolescents, nurse

SAŽETAK

Uvod: peristomalne i perifistularne komplikacije, naročito oštećenje kože uzrokovano vlagom (eng. Moisture-Associated Skin Damage - MASD), često su prisutne kod pacijenata sa stomom ili fistulom te mogu dovesti do bola, infekcija i odlaganja procesa zarastanja. Glavni faktori rizika uključuju nepravilnu primjenu sistema za prikupljanje sadržaja te nedostatak adekvatne edukacije zdravstvenog osoblja i pacijenata.

Prikaz slučaja: predstavljen je slučaj sedamnaestogodišnje pacijentice sa Crohnovom bolešću, kod koje je spontano formirana enterokutana fistula praćena izraženim oštećenjem kože usljed neadekvatne primjene stoma sistema. Identifikovani propusti u praksi, dan nakon prijema pacijentice, ukazali su na potrebu za dodatnom edukacijom medicinskih sestara. Sprovedena je korekcija sistema za zbrinjavanje sadržaja, tretman kože zaštitnim pastama i filmovima te sušenje kože na zraku. Istovremeno su sprovedene edukativne intervencije za medicinske sestre i pacijenticu, s ciljem prevencije daljih komplikacija i postizanja samostalnosti u njezi.

Rezultati: tokom hospitalizacije svakodnevno je vršena pažljiva njega perifistularne kože, a osmog dana od početka tretmana postignuta je epitelizacija kože, čime je smanjen rizik od infekcije. Pacijentica je do otpusta uspješno osposobljena za samostalnu primjenu sistema za njegu fistule, uz kontinuirani nadzor.

Zaključak: prikaz potvrđuje da pravilna procjena, edukacija i individualizirani pristup pacijentu predstavljaju ključne faktore uspješnog liječenja komplikacija vezanih za stome i fistule. Edukacija medicinskih sestara i pacijenata treba biti sastavni dio svakodnevne kliničke prakse, nezavisno od nivoa zdravstvene ustanove.

Ključne riječi: fistula, oštećenje kože, edukacija, stomalna njega, adolescenti, medicinska sestra

INTRODUCTION

Peristomal and perifistular complications, particularly moisture-associated skin damage (MASD), are common occurrences in patients with a stoma or fistula (1,2,3). Irritant contact dermatitis in individuals with a digestive stoma or fistula occurs when gastrointestinal secretions come into contact with the peristomal/perifistular skin, causing redness and irritation. Gastric and small intestinal secretions, rich in digestive enzymes such as bile, lipases, and proteases, further damage the skin (1,4). These complications most often occur due to improperly fitted stoma

systems or inadequate knowledge regarding their application (4,5).

In order to identify all internal and external factors influencing the development of such problems, it is essential to obtain a comprehensive medical history including biological, psychological, and social aspects, along with a detailed clinical examination. Only after causal and risk factors have been determined an evidence-based care and treatment plan can be developed, aimed at preventing complications and supporting the healing process. Patient and healthcare staff education, especially for nurses, is one of the key elements in preventing such complications and is part of the professional standards of nursing care (6).

Healthcare professionals often overlook the psychosocial needs of patients. These needs can be alleviated through relaxation techniques, therapy, and support (7). Nurses play a crucial role in providing education (8,9), organizing support groups, and assisting in addressing psychosocial issues (7).

CASE REPORT

Patient: an adolescent 17-years-old female, has been diagnosed with Crohn's disease since 2019. She has been receiving treatment at the Pediatric Clinic of the Clinical Center University of Sarajevo, with multiple hospitalizations. Over a longer period, continuous non-adherence to prescribed therapy and medical recommendations was documented, which negatively affected the course of the disease, leading to frequent exacerbations of her general clinical condition and complications of the underlying illness. To ensure comprehensive healthcare and psychosocial support, a multidisciplinary team was involved in her treatment, including physicians, nurses, a social worker, and a psychologist. Despite measures taken to strengthen therapeutic adherence and clearly defined parental responsibility for monitoring the therapeutic regimen, inadequate family support and persistently non-cooperative behavior on the patient's part were recorded, resulting in poor adherence. Due to worsening of her condition, on 10 August 2023, the

patient was transferred from a Cantonal Hospital (different Canton) to the Department of Gastroenterohepatology of the Clinical Center University of Sarajevo Pediatric Clinic.

Clinical findings on admission: the patient was clinically severely malnourished. A stoma pouch was placed in the lower right quadrant of the abdomen. During the examination, leakage of fecal content around the edges of the pouch was noted, requiring its removal and replacement. After removing the stoma pouch, it was noted that the opening on the adhesive base was cut too wide, allowing direct contact of stool with the damaged peristomal skin (Figure 1). Contrary to the previous diagnosis, which assumed a surgically created stoma (ileostomy), removal of the pouch revealed a spontaneously developed enterocutaneous fistula approximately 1 × 2 cm in size, not previously documented. In the peristomal region, skin damage measuring about 9 × 10 cm was observed, with pronounced erythema, a moist surface, signs of irritation, and possible early signs of secondary infection (Figure 2).

Medical history: the spontaneously developed enterocutaneous fistula represents a complication of the underlying disease. Based on the patient's medical history, it can be assumed that she did not receive adequate education or professional support from healthcare staff regarding proper care and replacement of the stoma pouch. In the facility from which she was transferred, the patient had been independently changing the stoma pouch without prior knowledge of correct application techniques. She was unaware of stoma pastes or the possibility of using systems with a hydrocolloid base, which ensure proper adhesion and provide protection to the peristomal skin, even in the presence of damage or exudate.

Although the patient does not have a surgically created stoma, the spontaneously formed fistula functions as an opening through which intestinal contents continuously drain onto the skin surface. Due to the similarity in physiological and mechanical stress on the peristomal region, the treatment of a fistula requires the same approach as that for stoma care.

This includes proper skin assessment, selection of an appropriate stoma pouch, correct application of the collection system, and implementation of measures to maintain skin integrity (1).

Education of Healthcare Staff: given that the nurse who participated in the patient's admission did not have prior experience in stoma care and, due to the patient's fear of applying the stoma pouch over the damaged skin area, wide cut of the stoma pouch opening, the lack of adequate knowledge and skills was identified among the nurses involved in the patient's direct care. This deficit particularly relates to the proper application of stoma appliances and the protection of peristomal skin. Deficiencies identified in nursing practice the day after the patient's admission indicated the need for additional education of nursing staff. Accordingly, the head nurse of the department initiated targeted education of the nursing team, with a special emphasis on proper skin assessment techniques, cutting the opening in the stoma pouch, application of protective pastes, and prevention of stoma system leakage. Based on the clinical examination and medical history, a nursing diagnosis was established, nursing care goals were defined, and interventions were planned in achieving the goals.

Nursing diagnoses: impaired skin integrity related to exposure to enteral content, inadequate application of the stoma system, and lack of self-care knowledge. Risk of skin damage related to improper application of the stoma system and fear of manipulation.

Primary goal: to restore the integrity of the peristomal skin region within 10 days from the start of treatment.

Preventive goals: reduce or eliminate contact between enteral content and skin within the next three days; prevent the occurrence of secondary infection through proper hygiene and local therapy. The patient will reduce fear of manipulation around the damaged skin area and actively participate in self-care of the stoma with support.

Educational goals: nurses will demonstrate competence in the assessment and application of appropriate protective products for the care of the skin around the fistula; the patient will acquire the knowledge and skills needed for the proper application of the stoma system and by the end of hospitalization correctly demonstrate placing and removing the stoma pouch.

Nursing Care Interventions

Skin care: gentle cleaning of the skin and drying of the area, using mild, low-irritant agents with low pH, lukewarm water, and soft cloths to reduce irritation and preserve the skin. Clean the skin at least once daily and immediately after each episode of fecal incontinence - this helps maintain skin integrity and prevent damage. Application of protective barrier films and pastes to the perifistular region (10); occasional air exposure of the fistula for drying and epithelialization.

Correction of the collection system (5): precisely cutting the opening in the stoma pouch according to the dimensions of the fistula, with a safety margin of 2 mm; education on correct positioning and securing of the system.

Staff education (4): internal training of nurses on skin assessment, proper use of stoma products, and patient monitoring, with an emphasis on responsibility in daily care.

Patient education (4,8,9): training for independent pouch replacement under supervision; explanation of the purpose and method of using protective pastes and barrier films; advice on hygiene maintenance and recognizing signs of complications.

Patient support (7): Encourage the patient to verbalize her fears and concerns; encourage gradual involvement of the patient in changing the stoma pouch under supervision; provide emotional support through open communication and affirmation of her progress.

RESULTS

Upon admission, the skin around the fistula was significantly damaged, with intense erythema, moisture, exudate, and signs of irritation (Figure 1). An inadequately placed stoma pouch with an overly wide opening worsened the condition. After taking appropriate measures such as correction of the system, local treatment, and drying, significant improvement was observed: on the fifth day, the skin was partially epithelialized (Figure 3), and on the tenth day completely dry and epithelialized, with no signs of irritation or exudate (Figure 4). The fistula opening was clean and stable.

Assessment and correction of the collection system: a detailed assessment of the system revealed that the previously used stoma pouch was not adequately adapted to the dimensions of the fistula, resulting in leakage of contents and skin irritation. The opening in the pouch was precisely adjusted to the dimensions of the fistula with a safety margin of 2 mm, enabling optimal adhesion and reducing the risk of stool contact with the skin. For additional protection, a specialized stoma paste was used to ensure a hermetic seal.

Skin treatment and epithelialization: local treatment included drying methods and skin regeneration. The fistula was regularly left without the system for several hours daily for air drying at room temperature, which encouraged epithelialization. The perifistular skin was treated with protective pastes and barrier films, preserving skin integrity and preventing further damage.

Evaluation of goals: the skin around the fistula showed signs of epithelialization and reduced erythema within eight days; stool leakage was eliminated by proper sealing and application of the system; the patient correctly and independently applies and removes the pouch while verbalizing understanding of the instructions, and verbalizes reduced fear related to stoma pouch placement, stating that she feels more confident in performing the procedure; the nursing staff records daily assessments and interventions in the nursing documentation; there are no signs of secondary infection or deterioration of the skin condition during hospitalization.



Figure 1 Day of Admission.



Figure 2 First Day After Admission.



Figure 3 Fifth Day of Hospitalization.



Figure 4 Eighth Day of Hospitalization.

DISCUSSION

Skin damage around the fistula caused by moisture represents a significant challenge in clinical practice, as constant contact of the skin with digestive secretions contributes to the development of irritant dermatitis and secondary infections, thereby prolonging the healing process and worsening patients' quality of life (1,3). The specificity of stomal and peristomal skin injuries requires a special approach in skin care, which includes the use of products with protective properties and precise adaptation of the stoma system to the patient's body (4,6).

Education of nurses plays a key role in preventing these complications, as their level of knowledge and practice directly influence the quality of care and treatment outcomes (11,12). The availability of specialized wound care nurses is not uniform across all healthcare institutions, which further highlights the

need for universal education programs and continuous professional development of healthcare staff (9, 10).

The use of advanced polymer protective films and hydrocolloid adhesives has shown to reduce friction and skin irritation around stomal openings, enabling better adhesion and skin protection while promoting its recovery (5,9). In addition, the correct selection of the stoma system and regular evaluation of its fit are crucial for minimizing the risk of skin damage, especially in patients with high fistula output (1,8,10).

Psychosocial aspects are also important in the context of stomal patient care. Education does not only cover technical aspects of care but also support for patients in coping with daily challenges, which is essential for their recovery and quality of life (7). A multidisciplinary approach involving nurses, wound care specialists, psychologists, and social workers can significantly improve treatment outcomes (8,9).

Although existing guidelines and protocols for the prevention of moisture-associated skin damage (MASD) are well defined, challenges in implementation persist in practice, necessitating continuous monitoring, documentation standardization, and further research to optimize care (2,10). In this regard, education of nursing staff on the latest technologies and protocols in stoma care is crucial for reducing complication incidence and improving patient outcomes (11,12).

Integrated education of healthcare staff, proper application of stoma systems, and a multidisciplinary approach represent the foundation for successful prevention and treatment of skin damage around fistulas/stomas. Such an approach not only reduces complications but also increases patient autonomy and quality of life (1,7,9).

CONCLUSION

Effective treatment of peristomal/perifistular skin damage requires a comprehensive approach involving professional medical knowledge, proper application of

stoma systems, active engagement of healthcare personnel, and systematic patient education. The successful outcome of this case confirms that through proper care, staff and patient education, skin damage can be healed within a relatively short time. It is essential to ensure that all members of the healthcare team, regardless of the level of the healthcare facility or department type, possess basic knowledge and skills in stoma care.

Ethical Considerations

The case was presented in full compliance with ethical principles and patients' rights. As the patient was a minor, written consent for the processing and presentation of clinical data, as well as for photographing and using images of the perifistular region, was obtained from the parents. Considering that the patient was 17-year-old adolescent, written consent was also signed by the patient herself. The patient's identity has not been disclosed in any part of the case presentation, and all privacy protection measures have been respected in accordance with professional standards and applicable ethical guidelines.

REFERENCES

1. McNichol L, Bliss DZ, Gray M. Moisture-Associated Skin Damage: Expanding Practice Based on the Newest ICD-10-CM Codes for Irritant Contact Dermatitis Associated With Digestive Secretions and Fecal or Urinary Effluent From an Abdominal Stoma or Enterocutaneous Fistula. *J Wound Ostomy Continence Nurs.* 2022;49(3):235-9. doi: 10.1097/WON.0000000000000873.
2. Gray M, Black JM, Baharestani MM, Bliss DZ, Colwell JC, Goldberg M, et al. Moisture-associated skin damage: overview and pathophysiology. *J Wound Ostomy Continence Nurs.* 2011;38(3):233-41. doi: 10.1097/WON.0b013e318215f798.
3. Paul JC, Zimnicki K, Pieper BA. Encountering Ostomies in Acute Care: Peristomal Skin Changes. *Adv Skin Wound Care.* 2023;36(1):54-5. doi:

- 10.1097/01.ASW.0000897288.52973.e1-
4. Dark J, Aquino M, Clat C. Ostomy skin care. *Wounds Int.* 2024; Suppl "Made Easy".
 5. Hill RH, Smith SL. Peristomal Moisture-Associated Skin Damage Treatment: Use of Cyanoacrylate Liquid Skin Protectant: A Case Series. *J Wound Ostomy Continence Nurs.* 2023;50(6):521-4. doi: 10.1097/WON.0000000000001027.
 6. Gray M, Weir D. Prevention and treatment of moisture-associated skin damage (maceration) in the periwound skin. *J Wound Ostomy Continence Nurs.* 2007;34(2):153-7. doi: 10.1097/01.WON.0000264827.80613.05.
 7. Ayaz-Alkaya S. Overview of psychosocial problems in individuals with stoma: A review of literature. *Int Wound J.* 2019;16(1):243-9. doi: 10.1111/iwj.13018.
 8. D'Ambrosio F, Pappalardo C, Scardigno A, Maida A, Ricciardi R, Calabrò GE. Peristomal Skin Complications in Ileostomy and Colostomy Patients: What We Need to Know from a Public Health Perspective. *Int J Environ Res Public Health.* 2022;20(1):79. doi: 10.3390/ijerph20010079.
 9. Albulescu EL, Bratiloveanu T, Sandulescu S, Ramboiu S, Nemes R, Surlin V, Chiuu L. Role of a Stoma Nurse in the Management of the Specific Stoma-Related Complications. *Curr Health Sci J.* 2024;50(1):5-11. doi: 10.12865/CHSJ.50.01.01.
 10. Boyles A, Voegeli D, Beeckman D, Fletcher J, Kottner J, McNichol L, et al. International Best Practice Recommendations: Prevention and management of moisture-associated skin damage (MASD). *Wounds International.* 2020. Available online at www.woundsinternational.com
 11. Duruk N, Uçar H. Staff nurses' knowledge and perceived responsibilities for delivering care to patients with intestinal ostomies: a cross-sectional study. *J Wound Ostomy Continence Nurs.* 2013;40(6):618-22. doi: 10.1097/WON.0b013e3182a9a7ed.
 12. Cross HH, Roe CA, Wang D. Staff nurse confidence in their skills and knowledge and barriers to caring for patients with ostomies. *J Wound Ostomy Continence Nurs.* 2014;41(6):560-5. doi: 10.1097/WON.0000000000000065.
- Declaration of Patient's Consent:** the authors certify that they have obtained the appropriate patient's consent form. In the form, the patient has granted his/her permission for the images and other clinical information to be reported in the journal.
- Authors' Contributions:** EM, AH, EK and EH contributed significantly to the conception and design of the article, as well as the acquisition, analysis, and interpretation of data for the work. Each author had a role in drafting of the article and the revision process. Each author gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
- Financial Support and Sponsorship:** nil.
- Conflict of Interest:** there are no conflicts of interest.

INSTRUCTIONS TO AUTHORS

Journal „Bosnian Journal of Health Sciences and Technologies“ publishes original research articles, professional, review and educative articles, case reports, criticism, reports professional news and other articles in the field of health sciences and technologies.

The journal is referral based, it follows a relevant database and is published three times a year: January, May and September.

Articles are written in extenso exclusively in English. Authors take responsibility for all the statements and attitudes in their articles. If an article is written by several authors, it is necessary to provide full contact details (telephone number and email address) of the corresponding author for the cooperation with the Editorial Board during preparation of the text to be published. The maximum number of authors is 7.

Authors should indicate whether the procedures carried out on humans were in accordance with the ethical standards of medical deontology and the Declaration of Helsinki (mandatory proof of the data obtaining methodology, informed consent of minor respondents, etc.).

Articles containing results of animal studies must clearly state that ethical standards were applied.

Articles are exclusively submitted on the following email address: bjhsteditorial@gmail.com

COVER LETTER

Along with their work, the authors should enclose a cover letter, containing a handwritten statement signed by all authors, to the Editorial Board of the “Bosnian Journal of Health Sciences and Technologies” stating that:

1. the work has not been previously published or accepted for publication in another journal;
2. the work has been approved by Ethical Committee;
3. the work, accepted for publication, becomes ownership of the BJHST

PREPARATION OF MANUSCRIPT

Articles should not be longer than 10 computer pages, including figures, graphs, tables and references.

Spacing: 1.5, left margin: 2.5 cm, right margin: 2.5 cm, top and bottom margin: 2.5 cm. Font: Times New Roman 12.

Graphs, tables, figures and images should be inserted and placed in the text section, where they belong, regardless of the program in which they were created.

ARTICLE CONTENT

TITLE

Should be concise and meet the objectives of the work, written in B/H/C and English language.

NAME AND SURNAME OF AUTHOR AND CO-AUTHOR

Name and full address of the institution where the author/co-author is employed, contact address.

ABSTRACT

Written in B/H/C and English language, containing a total of 200-250 words. Keywords are mandatory.

INTRODUCTION

The introduction is a short, concise part of the work containing the purpose of the work/problem in relation to other published works with a similar topic. It is necessary to define the problem, the aim of the research and/or set the work hypotheses. All is cited from the original literature.

MATERIALS AND METHODS

This part should contain a description of the original or modification of known scientific methods. If it is about the previously described method, it is sufficient to provide references in the literature. It is important that the research contains information about the type and period of the research.

If the research uses laboratory materials and other tests, it is necessary to state the sampling method. Research older than 5 years will not be considered for review and publication.

RESULTS

The main results of the research and the level of statistical significance should be quoted.

The results are presented in a tables or graphs, with clearly marked text and numerical notation.

The results must be statistically processed.

DISCUSSION

Discussion is concise and refers to own results which are then compared with other similar researches published in reference scientific databases. The discussion ends with confirmation or denial of the given goal or hypothesis.

CONCLUSION

It should be short and clear, mostly relate to crucial research data.

REFERENCES

Citation is required under the Vancouver Rules. 50% of the literature should not be older than 5 years. The exceptions are literary source data containing unchanging statements or well-founded definitions.

UPUSTVO ZA AUTORE

Časopis „Bosnian Journal of Health Sciences and Technologies“ objavljuje originalne naučne radove, stručne, pregledne i edukativne, prikaze slučajeva, recenzije, saopćenja, stručne obavijesti i drugo iz područja zdravstvenih nauka i tehnologija.

Časopis je referalan, prati relevantnu bazu podataka i izlazi tri puta godišnje: januar, maj i septembar.

Rad in extenso (cjelokupan) piše se isključivo na engleskom jeziku. Autori su odgovorni za sve navode i stavove u njihovim radovima. Ukoliko je rad pisalo više autora, potrebno je navesti tačnu adresu (uz telefonski broj i e-mail adresu) onog autora s kojim će uredništvo sarađivati pri uređenju teksta za objavljivanje. Maksimalan broj autora je 7.

Ukoliko su u radu prikazana istraživanja na ljudima, mora se navesti da su provedena u skladu sa načelima medicinske deontologije i Deklaracije iz Helsinkija. (obavezan dokaz o načinu dobivanja podataka, informirani pristanci ispitanika maloljetne dobi i sl.).

Ukoliko su u radu prikazana istraživanja na životinjama, mora se navesti da su provedena u skladu sa etičkim načelima.

Radovi se dostavljaju isključivo mailom i to na mail: bjhsteditorial@gmail.com

POP RATNO PISMO

Uz svoj rad, autori su dužni Redakciji Časopisa „Bosnian Journal of Health Sciences and Technologies“ dostaviti popratno pismo koje sadržava svojeručnu potpisanu izjavu svih autora:

1. navedeni rad nije objavljen ili primljen za objavljivanje u nekom drugom časopisu
2. da je istraživanje odobrila Etička komisija
3. da prihvaćeni rad postaje vlasništvo Časopisa

OPSEG I OBLIK RUKOPISA

Radovi ne smiju biti duži od 10 stranica na računaru, ubrajajući slike, grafikone, tabele i literaturu.

Prored: 1,5, lijeva margina: 2,5 cm, desna margina: 2,5 cm, gornja i donja margina: 2,5 cm. Font: Times New Roman 12.

Grafikone, tabele i slike unijeti i staviti u dio teksta, tamo gdje im je mjesto, bez obzira u kojem programu su rađene.

RAD SADRŽI:**NASLOV RADA**

koncizan i zadovoljava ciljeve rada, obavezno na jeziku naroda BiH i engleskom jeziku

IME I PREZIME AUTORA I KOAUTORA

Naziv i puna adresa institucije u kojoj je autor/koautor zaposlen, kontakt adresa

SAŽETAK

na jeziku naroda u BiH i engleskom jeziku, sa ukupno 200-250 riječi. Obavezno navesti ključne riječi

UVOD

Uvod je kratak, koncizan dio rada i u njemu se navodi svrha rada/problema u odnosu na druge objavljene radove sa sličnom tematikom. Potrebno je definisati problem, cilj istraživanja i/ili postaviti hipoteze rada. Sve navedeno se citira izvornom literaturom.

MATERIJAL I METODE

Potrebno je da sadrži opis originalnih ili modifikaciju poznatih naučnih metoda. Ukoliko se radi o ranije opisanoj metodi dovoljno je dati reference u literaturi.

U istraživanjima je bitno napisati koja je vrsta istraživanja i navesti period istraživanja.

Ako su korišteni testovi ili upitnici neophodno je navesti koje vrste upitnika i period provođenja.

Ukoliko su za istraživanje korišteni laboratorijski materijali i drugi testovi neophodno je navesti metodu uzorkovanja.

Istraživanja starija od 5 godina se neće uzeti u razmatranje za recenziju i objavu.

REZULTATI

Navode se glavni rezultati istraživanja i nivo statističke značajnosti. Rezultati se mogu prikazati tabelom ili grafikonom, sa jasno naznačenim tekstom i numeričkom oznakom.

Rezultati moraju biti statistički obrađeni.

DISKUSIJA

Piše se koncizno i odnosi se prvenstveno na vlastite rezultate, a potom se nastavlja komparacija sa drugim sličnim provedenim istraživanjima objavljenim u referalnim naučnim bazama. Diskusija se završava potvrdom ili negiranjem zadanog cilja ili hipoteze.

ZAKLJUČCI

trebaju biti kratki i vrlo jasni. Uglavnom se odnose na krucijalne podatke iz istraživanja.

LITERATURA

Citiranje je obavezno prema Vankuverskim pravilima. 50% literature ne treba biti starije od 5 godina. Izuzeće su literaturni izvorni podaci koji sadrže nepromijenjive navode ili utemeljene definicije.

NORMAVIL®

tablete 50 mg x 30

vildagliptin

NORMALNO JE BITI SLADAK ZA PETICU!



Pakovanje:
NORMAVIL® tableta 30 x 50 mg:
(br. rješenja: 04-07.3-1-1377/23 od 28.04.2023. god.)

Lijek se izdaje uz ljeakarski recept.
Bosnalijek, farmaceutska i hemijska industrija,
dioničko društvo, Jukićeva 53, Sarajevo, BiH.

 **BOSNALIJEK**
Prvo zdravlje!

BH.MOR.2025.02.

ODOBRENE INDIKACIJE: Odrasli: Kao dodatak dijeti i tjelovježbi radi poboljšanja glikemijske kontrole u pacijenata sa dijabetes melitusom tipa 2:

- Kao monoterapija u pacijenata u kojih je metformin neprikladan zbog kontraindikacija ili nepodnošenja.
- U kombinaciji s drugim lijekovima za liječenje dijabetesa, uključujući inzulin, kad oni ne pružaju adekvatnu glikemijsku kontrolu.

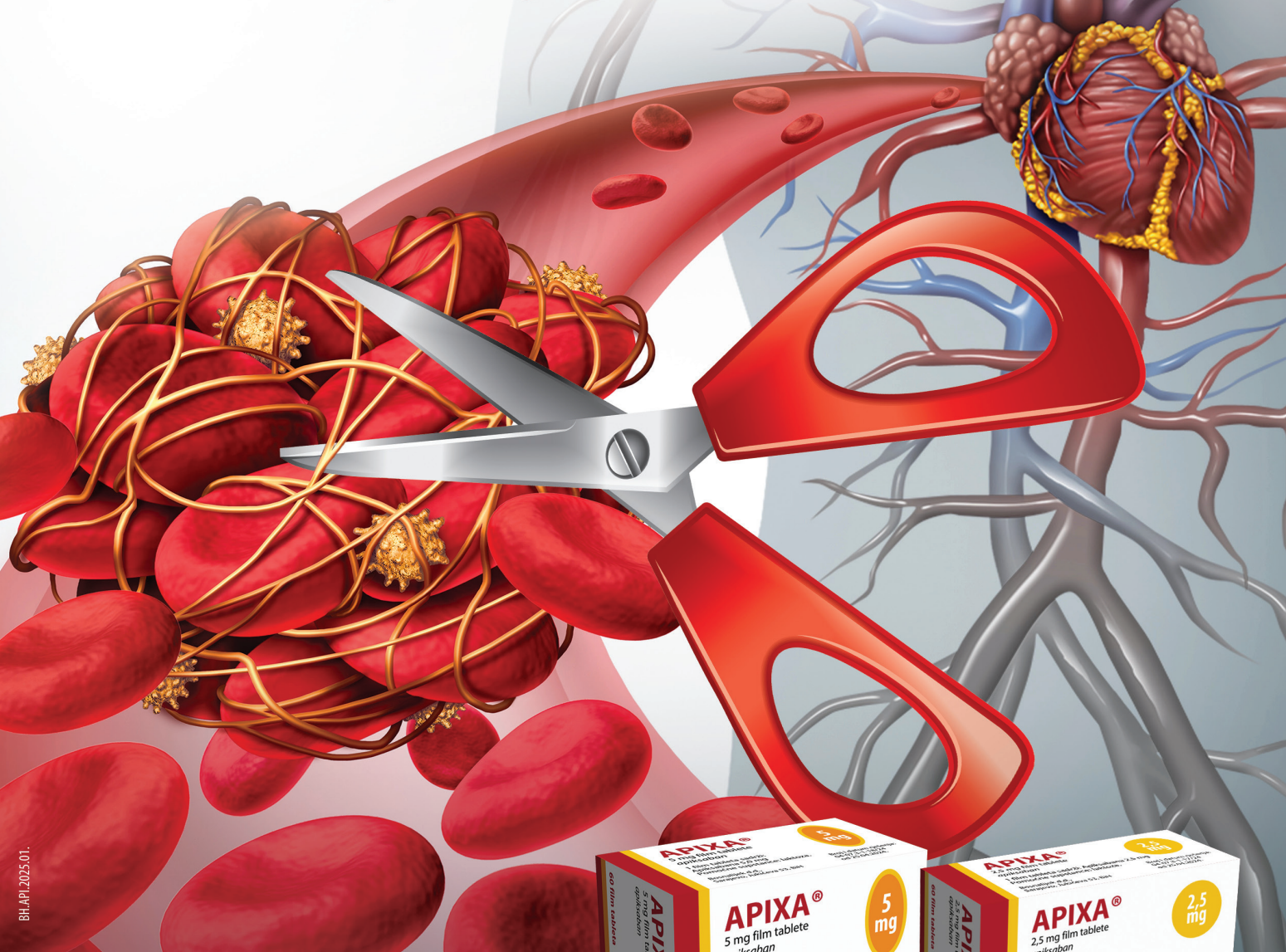
KONTRAINDIKACIJE: Preosjetljivost na aktivnu supstancu ili na bilo koju od pomoćnih supstanci. **NEZELJENA DJELOVANJA:** Infekcija gornjih disajnih puteva, omaglica, glavobolja, tremor, zamućen vid, konstipacija, mučnina, gastroezofagealna refluksna bolest, dijareja, bol u abdomenu, uključujući gornji dio, povraćanje, hiperhidroza, osip, svrbež, dermatitis, artralgija, mijalgija, astenija, periferni edem. **POSEBNA UPOZORENJA I MJERE OPREZA PRI PRIMJENI:** Lijek nije zamjena za inzulin u pacijenata koji trebaju inzulin. Ne treba se primjenjivati u pacijenata sa dijabetes melitusom tipa 1 ili za liječenje dijabetičke ketoacidoze. Oprez je potreban kod pacijenata u terminalnom stadiju bubrežne bolesti koji su na hemodijalizi. Ne treba se primjenjivati u pacijenata s oštećenjem jetre. Jetrenu funkciju treba pratiti tokom liječenja u intervalima od tri mjeseca tokom prve godine liječenja, te povremeno nakon toga. U pacijenata koji razvijaju žuticu ili druge znakove koji upućuju na disfunkciju jetre treba prekinuti liječenje. Ne preporučuje se primjena u pacijenata s NYHA funkcionalne klase IV. Preporučuje se praćenje kožnih poremećaja u dijabetičkih pacijenata. Potreban je oprez u pacijenata s anamnezom akutnog pankreatitisa. Pacijenti s rijetkim nasljednim poremećajem nepodnošenja galaktoze, potpunim nedostatkom laktaze ili malapsorpcijom glukoze i galaktoze ne bi smjeli uzimati ovaj lijek. Lijek ne treba primjenjivati tokom trudnoće i dojenja. **DOZIRENJE I NAČIN UPOTREBE:** Odrasli Kada se primjenjuje kao monoterapija, u kombinaciji s metforminom, u kombinaciji s tiazolidindionom, u kombinaciji s metforminom i sulfonilurejom, ili u kombinaciji s inzulinom (sa ili bez metformina), preporučena dnevna doza vildagliptina je 100 mg, primijenjena kao jedna doza od 50 mg ujutro i jedna doza od 50 mg navečer. Kada se primjenjuje u dvojnjoj kombinaciji sa sulfonilurejom, preporučena doza vildagliptina je 50 mg jedanput na dan, a primjenjuje se ujutro. Kada se primjenjuje u kombinaciji sa sulfonilurejom, niža doza sulfonilureje se može razmotriti kako bi se smanjio rizik od hipoglikemije. Ne preporučuju se doze veće od 100 mg. U starijih pacijenata i pacijenata s blagim oštećenjem bubrega (klirens kreatinina ≥ 50 ml/min) nije potrebno prilagođavati dozu. Lijek se može uzimati uz obrok ili bez obroka

Za sve detaljnije informacije o lijeku koristiti posljednji odobreni Sažetak glavnih karakteristika lijeka i Uputstvo o lijeku.

APIXA®

apiksaban

BOSNALIJEK
Prvo zdravlje!



BH.LAPI.2025.01.

KONAČNO SLOBODA!



Pakovanje:
APIXA® film tablete 60 x 2,5 mg:
(br. rješenja: 04-07.3-1-17/24 od 25.04.2024.)
APIXA® film tablete 60 x 5 mg:
(br. rješenja: 04-07.3-1-18/24 od 25.04.2024.)

Lijek se izdaje uz ljeakarski recept.
Bosnalijek, farmaceutska i hemijska industrija, dioničko društvo, Jukićeva 53, Sarajevo, BiH.

ODOBRENE INDIKACIJE: APIXA 2,5 mg: Prevencija venskih tromboembolijskih događaja (VTE) u odraslih pacijenata podvrgnutih elektivnom hirurškom zahvatu ugradnje umjetnog kuka ili koljena.

APIXA 2,5 mg i APIXA 5 mg: Prevencija moždanog udara i sistemske embolije u odraslih pacijenata s nevalvularnom fibrilacijom atrija (NVAF), koji imaju jedan ili više faktora rizika, poput, pretrpljenog moždanog udara ili tranzitorne ishemijske atake (TIA), dobi ≥ 75 godina, hipertenzije, šećerne bolesti, simptomatskog zatajenja srca (NYHA kategorija \geq II). Liječenje duboke venske tromboze (DVT) i plućne embolije (PE), te prevencija ponavljajućih DVT i PE u odraslih. **KONTRAINDIKACIJE:** Preosjetljivost na aktivnu supstancu ili na neku od pomoćnih supstanci. Aktivno, klinički značajno krvarenje. Bolest jetre povezana s koagulopatijom i klinički relevantnim rizikom od krvarenja. Lezija ili stanje koje se smatra značajnim faktorom rizika za veliko krvarenje (trenutno ili nedavno gastrointestinalnu ulceraciju, prisutnost malignih neoplazmi kod kojih postoji veliki rizik od krvarenja, nedavne ozljede mozga ili kičme, nedavni hirurški zahvat na mozgu, kralježnici ili očima, nedavno intrakranijalno krvarenje, utvrđene ili suspektne varikozitete jednjaka, arteriovenske malformacije, vaskularne aneurizme ili velike intraspinalne ili intracerebralne vaskularne abnormalnosti). Istovremeno liječenje bilo kojim antikoagulantom, npr. nefrakcioniranim heparinom, heparinima niske molekulske težine (enoksaparin, dalteparin itd.), derivatima heparina (fondaparinuks itd.), oralnim antikoagulantima (varfarin, rivaroksaban, dabigatran itd.), osim pri specifičnim okolnostima promjene antikoagulantne terapije, kada se nefrakcionirani heparin daje u dozama neophodnim za održavanje centralnog venskog ili arterijskog katetera otvorenim ili kada se nefrakcionirani heparin daje tokom kateterske ablacije zbog fibrilacije atrija. **POSEBNA UPOZORENJA I MJERE OPREZA:** Preporučuje se pažljiva primjena kod bolesti praćenih povećanim rizikom od krvarenja. Primjenu apiksabana treba prekinuti ako se dogodi teško krvarenje. Istovremena primjena apiksabana s antitrombotičnim lijekovima povećava rizik od krvarenja. Oprez je potreban ako se pacijenti istovremeno liječe selektivnim inhibitorima ponovnog preuzimanja serotonina (SSRI) ili inhibitorima ponovnog preuzimanja serotonina i noradrenalina (SNRI), ili nesteroidnim antiinflamatornim lijekovima (NSAIL), uključujući i acetsalicilnu kiselinu (ASK). U pacijenata s fibrilacijom atrija i sa stanjima koja zahtijevaju monoterapiju ili dvojni terapiju antitrombotičnim lijekovima, potrebno je provesti pažljivu procjenu potencijalnih koristi naspram potencijalnih rizika prije kombiniranja takve terapije s apiksabanom. **NEŽELJENA DJELOVANJA:** Anemija, krvarenje u oku, krvarenje hematom, hipotenzija (uključujući hipotenziju tokom procedure), epistaksa, mučnina, krvarenje u probavnom sistemu, rektalno krvarenje, krvarenje iz gingive, povećana gama-glutamilttransferaza, hematurija, kontuzija. **DOZIRANJE I NAČIN UPOTREBE:** APIXA 2,5 mg: Prevencija VTE (VTEp): elektivni hirurški zahvatu ugradnje umjetnog kuka ili koljena: Preporučena doza apiksabana je 2,5 mg oralno, dva puta na dan. Početnu dozu treba uzeti 12 do 24 sata nakon hirurškog zahvata. Preporučeno trajanje liječenja u pacijenata podvrgnutih hirurškom zahvatu ugradnje umjetnog kuka je 32 do 38 dana, a za ugradnju umjetnog koljena je 10 do 14 dana. APIXA 2,5 mg i APIXA 5 mg: Prevencija moždanog udara i sistemske embolije u odraslih pacijenata s nevalvularnom fibrilacijom atrija (NVAF): Preporučena doza apiksabana je 5 mg oralno, dva puta na dan. Liječenje treba biti dugotrajno. Liječenje duboke venske tromboze (DVT) i plućne embolije (PE): Preporučena doza apiksabana je 10 mg oralno dva puta na dan, tokom prvih 7 dana, nakon čega slijedi 5 mg oralno dva puta na dan. U skladu s dostupnim medicinskim smjernicama, kratko trajanje liječenja (najmanje 3 mjeseca) treba temeljiti na prolaznim faktorima rizika. Prevencija ponavljajućih DVT i PE: Preporučena doza apiksabana je 2,5 mg oralno dva puta na dan. Kada je indicirana prevencija ponavljajućih DVT i PE, treba započeti s dozom od 2,5 mg dva puta na dan, a nakon završetka 6-mjesečnog liječenja apiksabanom u dozi 5 mg dva puta na dan ili s drugim antikoagulantom.

Za sve detaljnije informacije o lijeku koristiti posljednji odobreni Sažetak glavnih karakteristika lijeka i Uputstvo o lijeku.