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# HEALTH BULLETIN

## *Zdravstveni glasnik*


Faculty of Health Studies
University of Mostar

# Health Bulletin

## Zdravstveni glasnik

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# EDITORIAL

Dear esteemed readers of our journal,

We are pleased to present the twenty-first edition of the electronic journal Health Bulletin, featuring a diverse collection of articles in the field of healthcare. Our commitment remains steadfast in maintaining the high standards we have achieved while continuously striving to enhance the quality of our publication. We take great pride in being indexed in 19 online databases and in our ongoing progress each year.

I am grateful to have the support of outstanding colleagues — Josip Šimić, PhD; Roberta Perković, PhD; and Darjan Franjić, PhD — as well as the invaluable backing of our Dean, Professor Vajdana Tomić, MD, PhD. Looking ahead, we aim to expand our reach by including contributions from authors worldwide and securing indexing & abstracting in additional international databases.

This issue features thirteen excellent works, including nine original scientific papers, three professional articles, and one case report, authored by our current and former students, doctoral candidates, and faculty members.

I hope that reading the Health Bulletin will enrich your knowledge on selected topics, support your practical work, and inspire you to consider submitting your own research for publication in our journal. I extend my sincere thanks to everyone who contributed to this issue and warmly invite all interested authors to submit their manuscripts in English for upcoming editions.

Mostar, May 2025 Dragan Babić

# MENTAL HEALTH AND QUALITY OF LIFE OF STUDENTS AT THE FACULTY OF HEALTH STUDIES, UNIVERSITY OF MOSTAR

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## ABSTRACT

Introduction: Mental health and quality of life are key aspects of students' daily functioning, and circumstances such as living conditions can significantly influence them. Given the increasing number of young people facing psychological difficulties during their studies, researching the relationship between lifestyle and mental health is of great importance. Objective: To examine the mental health and quality of life of students at the Faculty of Health Studies, University of Mostar. Subjects and Methods: A cross-sectional study was conducted. The research included 150 participants: 84 students living as tenants (study group) and 66 students living with their parents (control group). Data were collected using a sociodemographic questionnaire specifically designed for this study, the World Health Organization Quality of Life-BREF (WHOQOL-BREF) questionnaire, and the Symptom Checklist-90-R (SCL-90-R) self- assessment questionnaire for psychological symptoms. Results: A statistically significant difference was found between students living as tenants and those living with their parents in the psychological symptom self-assessment scale. Tenants scored significantly higher (p<0.001) in the domains of Somatization, Obsessive Compulsive Disorder, Interpersonal Sensitivity, Depression, Anxiety, Hostility/Aggression, Phobic Anxiety, and Paranoid Ideation. There was no statistically significant difference in quality of life between students living with their parents and those living as tenants (p<0.005). Conclusion: Students living as tenants exhibit higher levels of psychological symptoms. However, there is no statistically significant difference in quality of life between students living as tenants and those living with their parents, regardless of the domain.

**Keywords**: Mental health, quality of life, students

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## INTRODUCTION

Mental health is essential both from a personal and societal perspective. According to the WHO, mental health (often equated with normal functioning) is a state of well-being in which an individual realizes their potential, copes successfully with the normal stresses of life, works productively, and contributes to their community (1). It is important to emphasize that mental disorders or illnesses are most often the result of interactions between biological inheritance, social influences, and adverse stressful situations (2).

Quality of life (QoL) has recently become a central topic in mental health care (3). The individual's perspective and person-centered care have gained increased importance, with the improvement of overall well-being now regarded as just as significant as the absence of symptoms. Ultimately, improving QoL is considered an important treatment outcome (4).

These changes have led to increased attention being paid to the impact of psychiatric disorders on daily functioning, well-being, and environmental resources. Although there is no universal definition of QoL, it is widely accepted that it encompasses both objective and subjective dimensions (5, 6).

Objective dimensions of QoL refer to tangible aspects such as living conditions or financial status. Subjective dimensions involve one's sense of well-being and satisfaction. Previous studies have explored the relationship between objective and subjective QoL, which appears to be weak to moderate (7).

Some authors note that psychiatric symptoms are the strongest independent predictors of both subjective and objective QoL in patients with schizophrenia (8). Certain studies suggest that higher subjective QoL scores are found in older patients, those with paid employment, and those with lower symptom severity (9).

Numerous objective and subjective factors play a role in the quality of life of individuals with severe mental health issues (10, 11).

Students are particularly exposed to unique pressures such as adjusting to a new social and physical environment and changes in their social networks. High academic demands are placed on them in order to achieve their desired career goals. As a result, students may develop greater self-awareness and readiness to acknowledge their inner conflicts, fears, and doubts about themselves and their future compared to other populations (12).

Protecting young people's health, in all its aspects—physical, mental, and social—is a major responsibility for all parts of society (13).

Lack of time for rest and physical activity may lead to unhealthy eating habits, alcohol consumption, smoking, and the use of psychoactive substances. In addition, students go through an adaptation process that requires them to change their previous lifestyles to cope with academic demands (14).

Positive mental health among students includes various aspects, such as a positive self-image, the ability to maintain healthy relationships, empathy for others, the ability to cope with stress and emotions, and the development of personal capabilities. It also involves critical thinking, making well-considered decisions, and the ability to solve problems creatively. These factors are not only essential for students' personal well-being

but also for their academic success and social integration (15).

The aim of this study was to examine the mental health and quality of life of students at the Faculty of Health Studies, University of Mostar.

## PARTICIPANTS AND METHODS

A cross-sectional study was conducted at the Faculty of Health Studies, University of Mostar. The study included 150 participants: 84 students living as tenants (study group) and 66 students living with their parents (control group).

For data collection, the following instruments were used: a sociodemographic questionnaire specifically designed for this research, the standardized World Health Organization Quality of Life Questionnaire – WHOQOL-BREF, and the Symptom Checklist-90-R (SCL-90-R).

The custom-designed sociodemographic questionnaire included the following data: gender, age, place of residence (tenant or not), economic status, religiosity, alcohol consumption, smoking habits, year of study, grade point average, satisfaction with academic performance, and weekly physical activity.

The WHOQOL-BREF quality of life questionnaire was developed by the World Health Organization (WHO). It consists of 26 items that provide a profile of quality of life across four domains: physical health, psychological health, social relationships, and environment. The scale is positively oriented, meaning that higher scores indicate a better quality of life (16).

The SCL-90-R (Symptom Checklist-90-R) measures nine dimensions of mental health symptoms: somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, phobic anxiety, hostility, and paranoid ideation. It consists of 90 items through which students self-assess their psychological symptoms based on the intensity of occurrence (ranging from “not at all” to “extremely”) (17).

All questionnaires used were standardized, validated, and approved by their respective authors for use in this research. Before completing the questionnaires, participants were informed about the purpose and objectives of the study and were assured of complete anonymity.

## STATISTICAL ANALYSIS

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) for Windows, version 26.0 (IBM, Armonk, New York, USA).

Descriptive statistical methods were used. The Kolmogorov–Smirnov (K–S) test was applied to assess the normality of data distribution.

Arithmetic mean was used as a measure of central tendency, while standard deviation was used as a measure of dispersion. Data are presented in tables using absolute and relative values.

Among non-parametric tests, the chi-square test ($\chi^2$) was used to determine whether there was a significant difference between observed and expected frequencies of respondents’ characteristics (stress levels, economic status, frequency of physical activity) in relation to the group. Among parametric tests, one-way analysis of variance (ANOVA) and Student’s t-test were used to assess differences between the two groups in terms of age, psychological symptom scale scores, and quality of life.

A p-value of less than 0.05 (p<0.05) was considered statistically significant.

## RESULTS

The first part of the questionnaire collected personal data about the participants. A higher number of female than male students was recorded in both groups. Among tenants, there were 60 women (71.4%) and 24 men (28.6%), while among those living with their parents there were 51 women (77.3%) and 15 men (22.7%). Most participants were in their first or second year of study, with the fewest in the third and fifth years. There were no third-year students among the tenants.

A statistically significant difference in perceived stress was found between the groups. Tenants reported high levels of stress significantly more often, whereas students living withtheir parents more frequently reported rarely experiencing stress (p<0.001).

A statistically significant number of participants in both groups reported good economic status (p=0.021), with 58.3% of tenants and 77.3% of those living with their parents indicating this. Tenants exercised less frequently than students who lived with their parents.

The sociodemographic characteristics of the sample are presented in Table 1.

**Table 1.** *Sociodemographic Characteristics of the Sample*

| | **Sample** | | | | **$\chi^2$** | **p** |
|---|---|---|---|---|---|---|
| | Lodgers | | Living with parents | | | |
| | **N** | **%** | **N** | **%** | | |
| **Gender** | | | | | 0.656 | 0.418 |
| Male | 24 | 28.6 | 15 | 22.7 | | |
| Female | 60 | 71.4 | 51 | 77.3 | | |
| **Year of Study** | | | | | 3.152 | 0.533 |
| 1 | 32 | 38.1 | 19 | 28.8 | | |
| 2 | 30 | 35.7 | 23 | 34.8 | | |
| 3 | 0 | 0 | 1 | 1.5 | | |
| 4 | 17 | 20.2 | 18 | 27.3 | | |
| 5 | 5 | 6 | 5 | 7.6 | | |
| **Stress** | | | | | 76.299 | 0.000 |
| None | 0 | 0 | 5 | 7.6 | | |
| Rarely | 6 | 7.1 | 44 | 66.7 | | |
| Occasionally | 36 | 42.9 | 14 | 21.2 | | |
| Often | 42 | 50 | 3 | 4.5 | | |
| **Economic Status** | | | | | 7.707 | 0.021 |
| Good | 49 | 58.3 | 51 | 77.3 | | |
| Average | 34 | 40.5 | 13 | 19.7 | | |
| Poor | 1 | 1.2 | 2 | 3 | | |
| **Exercise Frequency** | | | | | 4.618 | 0.202 |
| Never | 10 | 11.9 | 5 | 7.6 | | |
| Very rarely | 29 | 34.5 | 18 | 27.3 | | |
| Rarely | 23 | 27.4 | 29 | 43.9 | | |
| Often | 22 | 26.2 | 14 | 21.2 | | |

Note: N – total number; % – percentage; M – male; F – female; $\chi^2$ – Chi-square test; p – level of significance

There is a statistically significant difference in age in relation to place of residence. Older students predominantly live as tenants, while the younger population tends to live with their parents (t = -3.838; F = 19.699; p < 0.05).

Regarding the SCL-90 questionnaire, statistically significant differences were found between tenants and students living with their parents across all scale factors, except for the psychoticism domain (Table 2).

**Table 2.** *Differences in Results Obtained Using the SCL-90 Questionnaire*

| | **Sample** | | | | | |
|---|---|---|---|---|---|---|
| | Lodgers | | Living with parents | | **T** | **p** |
| | **M** | **SD** | **M** | **SD** | | |
| Somatization | 1.68 | 0.46 | 1.40 | 0.39 | 3.960 | <0.001 |
| Obsessive-compulsive disorder | 1.89 | 0.55 | 1.54 | 0.45 | 4.295 | <0.001 |
| Interpersonal sensitivity | 1.89 | 0.63 | 1.43 | 0.43 | 5.259 | <0.001 |
| Depression | 1.81 | 0.63 | 1.46 | 0.44 | 3.974 | <0.001 |
| Anxiety | 1.79 | 0.49 | 1.46 | 0.40 | 4.425 | <0.001 |
| Hostility/Aggressiveness | 1.59 | 0.53 | 1.32 | 0.31 | 3.852 | <0.001 |
| Phobic anxiety | 1.50 | 0.53 | 1.28 | 0.42 | 2.841 | 0.005 |
| Paranoid ideation | 2.04 | 0.80 | 1.50 | 0.46 | 5.153 | <0.001 |
| Psychoticism | 1.53 | 0.46 | 1.35 | 0.44 | 2.393 | 0.054 |
| Additional symptoms | 1.66 | 0.50 | 1.42 | 0.44 | 3.125 | 0.002 |

Note: M – mean; SD – standard deviation; t – Student's t-test; p – significance level

Table 3 presents the differences in quality of life between the examined groups. There are no statistically significant differences in quality of life between students living with their parents and those living as tenants.

**Table 3.** *Differences in Quality of Life Among the Examined Groups*

| | **Sample** | | | | | |
|---|---|---|---|---|---|---|
| | Lodgers | | Living with parents | | **T** | **P** |
| | **M** | **SD** | **M** | **SD** | | |
| Physical health | 13.55 | 1.804 | 13.95 | 1.656 | 1.387 | >0.05 |
| Psychological health | 12.94 | 4.337 | 13.50 | 4.618 | 1.946 | >0.05 |
| Social relationships | 16.60 | 3.429 | 16.24 | 2.631 | -0.480 | >0.05 |
| Environment | 15.58 | 2.531 | 16.40 | 2.605 | 1.958 | >0.05 |

Note: M – mean; SD – standard deviation; t – Student's t-test; p – significance level

## DISCUSSION

This study analyzed the mental health and quality of life of students at the Faculty of Health Studies. The results obtained from the sociodemographic questionnaire and the SCL-90 were consistent with expectations, in contrast to the results from the WHOQOL-BREF questionnaire, which did not support our hypothesis that there would be a significant difference in quality of life between students living as tenants and those living with their parents.

The results of the SCL-90 questionnaire indicate that students living as tenants report significantly higher levels of psychological symptoms across nearly all dimensions, including somatization, depression, anxiety, and others—except for

psychoticism. This suggests that living independently in rented accommodation may be associated with greater psychological burden.

Based on the WHOQOL-BREF results, which showed no statistically significant differences in perceived quality of life between tenants and students living with their parents across domains of physical health, psychological health, social relationships, and environment, we may conclude that perceived quality of life is not directly related to increased stress or psychological symptoms. Our findings contrast with some previous studies that have reported a significant negative correlation between depression, stress, and quality of life among students (18).

Students living with their parents reported lower levels of psychological symptoms, suggesting potential protective factors associated with the family environment. Abonassir and colleagues confirm our findings by highlighting the importance of parental support as a protective factor in maintaining mental health (19). On the other hand, findings from a study by Milošević and colleagues suggest that living with parents contributes to higher levels of depression among students (20).

The developmental stage of young people transitioning into adulthood involves many challenges, and students are particularly vulnerable to stress as they adapt to this new phase of life. The university period is often associated with emotional and psychological turmoil, as the prevalence of mental disorders is highest before the age of 24. Students are faced with various stressors, such as academic demands, building stable romantic relationships, financial difficulties, and balancing family and academic responsibilities. In addition, relocating to a new social environment and separation from home may further hinder the adjustment process, making students more vulnerable to emotional difficulties (18).

University counseling services report an increasing number of students seeking help for mental health issues. These problems often negatively affect students' learning capacity, which can result in poor academic performance. Although there is no conclusive evidence that students are more prone to these health issues, social pressures on students have increased in recent years. Greater competitiveness, financial demands, and rising aspirations for material security are among the contributing factors.

In recent years, there has been a noticeable increase in the number of students experiencing serious psychological problems, leading to growing interest in student mental health. While periods of stress, anxiety, and depression are common and normal for student populations, prolonged exposure to stress can result in more serious issues such as anxiety disorders, social withdrawal, and even severe illnesses (21).

Quality of life represents an individual's personal perception of their position in life, within the context of their culture, value system, goals, expectations, and interests. It is shaped by physical and psychological health, personal beliefs, social relationships, and the sense of meaning or rationality present in one's life. Various questionnaires are used to assess multiple dimensions of an individual's life in evaluating quality of life. Although there is no unified definition, most researchers agree that quality of life has two key

components: subjectivity and multidimensionality.

Quality of life is primarily a psychological construct that reflects an individual's general attitude toward life and its various aspects. Like any other attitude, it involves both cognitive and affective components, with life satisfaction forming the emotional part of this attitude. Quality of life is a multidimensional concept encompassing the perception of both positive and negative aspects of physical, emotional, social, and cognitive functioning (22).

Previous research on quality of life among the general population shows that students differ from the rest of society and are often highlighted as a distinct group. Data from studies conducted in Western countries consistently show that students report a lower quality of life compared to the general population, and that results within student samples are often more homogeneous. Possible explanations for these findings include students' poor financial situations, dependence on their parents, and a delayed transition into adulthood and the workforce. Regardless of the cause, research consistently demonstrates lower quality of life among students in both developed and developing countries (23).

The results of this study revealed that students exercise infrequently. Numerous studies have shown that physical activity significantly contributes to better mental health and that individuals who participate in sports exhibit fewer psychological symptoms (24–26).

Several studies investigating quality of life and mental health have been conducted at the Faculty of Health Studies, University of Mostar. Tadić and colleagues report that students living with their parents have a higher quality of life than those living in student dormitories (27). In contrast to our findings, results from a study by Šimić and Babić show that students living with their parents report both better quality of life and more frequent alcohol consumption compared to students living as tenants (28).

Certain limitations should be considered when interpreting the findings of this study. The data were collected via self-report questionnaires, which rely on the honesty of participants and may therefore lead to biased responses. Furthermore, the use of surveys did not allow for deeper analysis or contextual exploration of the answers. We recommend that future studies incorporate focus group interviews to gather more subjective insights into participants' attitudes. In studies of this design, there is always the possibility that participants misunderstood some questions, which may have led to overly subjective or inaccurate responses.

## CONCLUSIONS

Students living as tenants more frequently report high levels of stress, whereas those living with their parents more often report rarely experiencing stress. There is a statistically significant difference in psychological symptoms between the two groups. Students living as tenants exhibit significantly higher levels of psychological symptoms. In contrast, students living with their parents show better mental health and lower stress levels, while their perceived quality of life remains comparable across both groups. This highlights the potential protective role of the family environment, as well as the complexity of life perception among students.

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# DUŠEVNO ZDRAVLJE I KVALITETA ŽIVOTA STUDENATA FAKULTETA ZDRAVSTVENIH STUDIJA SVEUČILIŠTA U MOSTARU

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## SAŽETAK

Uvod: Duševno zdravlje i kvaliteta života studnata predstavlja ključne aspekte njihova svakodnevnog funkcioniranja, a okolnosti poput životnih uvjeta mogu značajno utjecati na njih. S obzirom na sve veći broj mladih ljudi koji se suočavaju s psihološkim teškoćama tijekom studiranja, istraživanje povezanosti između načina života i duševnog zdravlja postaje od velike važnosti. Ovaj rad istražuje kako način života, život kod roditelja u odnosu na život kao podstanar utječena duševno zdravlje i kvalitetu života studenata Fakulteta zdravstvenih studija u Mostaru.

Cilj istraživanja je ispitati duševno zdravlje i kvalitetu života studenata Fakulteta zdravstvenih studija, uspoređujući studente koji žive kod roditelja i one koji žive kao podstanari.

Ispitanici i postupci: Istraživanje je provedeno na Fakultetu zdravstvenih studija u Mostaru. U istraživanju je uključeno 150 ispitanika, od kojih 84 čine istnu skupinu odnosno studenti koji žive kao podstanari, a 66 ih čine kontrolnu skupinu tj. studenati koji žive kod roditelja. Podaci su prikljupljeni na osnovu trodjelnog upitnika i obrađeni od stane stručnjaka za statistiku.

Rezultati: Rezultati su pokazali da studenti koji žive kao podstanari iskazuju značajno više psiholoških simptoma, uključujući somatizaciju, anksioznost i depresiju, u usporedbi sa studentima koji žive kod roditelja. Međutim, nije utvrđena statistički značajna razlika u kvaliteti života između dviju skupina prema rezultatima WHOQOL-BREF upitnika. Iako su studenti koji žive s roditeljima imali bolju percepciju duševnog zdravlja, razlike u kvaliteti života bile su minimalne.

Zaključak: Studenti koji žive kod roditelja pokazuju bolje psihičko zdravlje i manje stresa u odnosu na podstanare, dok kvaliteta života ostaje na sličnoj razini u obje skupine.

**Ključne riječi:** duševno zdravlje, kvaliteta života, studenti, fakultet zdravstvenih studija.

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# TRANSLATION, CROSS-CULTURAL ADAPTATION, AND PSYCHOMETRIC EVALUATION OF THE BOSNIA AND HERZEGOVINA VERSION OF THE FOOT AND ANKLE OUTCOME SCORE IN PATIENTS WITH ANKLE SPRAIN: A CROSS-SECTIONAL STUDY

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## ABSTRACT

Objectives: To translate, adapt, and evaluate the psychometric properties of the Bosnia and Herzegovina version of the Foot and Ankle Outcome Score (BH-FAOS) in patients with ankle sprain.

Methods: In this cross-sectional study, 55 patients with ankle sprains were included. Four psychometric measures were assessed: construct validity (correlation of FAOS and Short Form Quality of Life Questionaire – SF-12), content validity (the patient's perception of the importance of FAOS questions), reliability (test-retest and internal consistency, Bland-Altman analysis), and responsiveness (after physical therapy intervention).

Results: Satisfactory construct validity was determined. All subscales of FAOS were in moderate correlation ($r > 0.3$) with the physical and mental health components of the SF-12 ($r>0.30$). All FAOS subscales demonstrated excellent reliability [Interclass Correlation Coefficient (ICC) values >0.90; Cronbach's alpha values ≥0.98].

Conclusions: The BH-FAOS is a reliable and valid instrument for assessing outcomes in patients with ankle sprains. The acceptable reliability and construct validity make it suitable for research and clinical purposes. Future studies are needed to establish psychometric properties for patients with different foot and ankle problems.

**Keywords**: Translation; Cross-Cultural Comparison; Psychometrics; Outcome Assessment, Health Care; Ankle Injuries

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## INTRODUCTION

Ankle sprains are a common global health problem in the world's population, especially among athletes, physically active individuals, children, teenagers, young people, and women (1-3). Ankle sprain injury occurs due to awkward rolling, twisting, or turning of the ankle. This leads to stretching or tearing of the ligaments whose function is to keep the ankle bones together, stabilize the ankle joints, and prevent excessive range of motion of the foot (1, 4).

Clinically, ankle sprains are characterized by swelling, pain, loss of function, decreased postural control, strength deficit, and reduced range of motion in the foot (5). The intensity of these symptoms depends on the degree of damage to the ligaments and ankle joint. There are three grades of ankle sprain: a) Grade I, mild ankle sprain, b) Grade II, moderate sprain/micro ligament lesions and c) Grade III, severe sprain, complete ligament rupture. Depending on these grades presence of the symptoms of ankle sprain can vary from a few days to a few months (6, 7). However, the most important fact regarding ankle sprains is frequent re-injury and thereby the development of chronic ankle instability (CAI) (1, 8). The occurrence of CAI can lead to changes in motor patterns, impaired quality of life, and the development of osteoarthritis (1, 5, 9). Thus, insufficient treatment and outcome evaluation of initial ankle injuries often can cause CAI (10).

Patient-reported outcome measures (PROMs), either general or body region–specific, are a central part of investigating outcomes of foot and ankle disorders in both clinical practice and research. Thus, the need for a validated patient outcome measurement tool is evident (11, 12). One of the most common PROMs for foot and ankle joint problems confirmed by the International Ankle Consortium is the Foot and Ankle Outcome Score (FAOS) (13). The FAOS was developed in 2001 to evaluate the patient's perception of their foot and ankle-related pain, symptoms, and functional limitations in daily life and sport, as well as quality of life (14, 15).

So far, FAOS has been translated and validated in most countries and regions worldwide for use in surgical and nonsurgical foot and ankle pathology (13, 14). However, there is no validated version for use in Bosnia and Herzegovina (BH), nor any of its official languages (Croatian, Serbian and Bosnian) (14).

This study aimed to translate, adapt, and evaluate the psychometric properties of the BH version of the Foot and Ankle Outcome Score (FAOS) in patients with ankle sprain. This includes assessing the reliability, validity, and usability of the adapted version in accurately measuring functional outcomes in this patient population.

## METHODS AND PARTICIPANTS

### Study design

This was a cross-sectional study. The study was approved by the Ethics Committee of the Rehabilitation Center "Život", Mostar, Bosnia and Herzegovina (ID: 002/2024, 24.1.2024). All the study methods were in line with the Declaration of Helsinki. Participants signed the written informed consent. Consolidated Standards of Reporting Cross-sectional Study

(STROBE), as well as Consensus-based Standards for the selection of Health Measurement Instruments (COSMIN) guidelines were followed in the design and reporting of the study. This study was conducted from February to October 2024.

## Participants

The convenience sample was used. Inclusion criteria were: diagnosis of acute ankle sprain made by a specialist physician, all genders, age >18 years, and willingness to participate in the study. Exclusion criteria were: ankle sprain with fractures of bones, other foot and ankle pathology, other musculoskeletal problems and previous surgical interventions that can affect the patient's perception, neurologic, cardiac, vascular and metabolic disease, as well as mental disorders and conditions that make it impossible to understand the questionnaire.

## Instruments

The participants were asked to fill out FAOS and Short Form Quality of Life Questionnaire (SF-12). All participants self-completed the questionnaires in paper format.

## The FAOS

The original English version and scoring system of the FAOS were downloaded from Mapi Research Trust (14). The FAOS consists of 42 questions divided into five subscales: Symptoms (seven questions), Pain (nine questions), Activities of Daily Living (ADL) (17 questions), Sports and Recreational Activities (Sports & Rec) (five questions), and Foot and Ankle-Related Quality of Life (QOL) (four questions). Each question is answered on a five-point Likert scale. For each item, the recall period is the past week. This self-administered questionnaire is scored from 0 (extreme symptoms) to 100 (no symptoms or limitations) for each subscale. FAOS scores are reported by subscale only; the total score is not calculated (15, 16). The average time to complete the FAOS is 10 minutes (17, 18).

## Translation procedure

The translation of the BH version of FAOS was carried out according to the instructions for Cross-Cultural Adaptation of Self-Report Measures (19). The English version of the FAOS was translated by two native translators and English language experts, one of whom is a healthcare professional. The three versions were compared and a consensus was reached for the prefinal version by two translators and an investigator. The prefinal version was used in a back-translation (Croatian to English) by an English translator with no prior knowledge of the FAOS original version. In the presence of all translators, the first translation version (synthesis), the back translation version, and the original English version of FAOS were compared; the result of this meeting created new a pre-final version of the BH FAOS. A pilot study with a random selection of participants with an ankle and foot injury (n=22) was conducted to exclude the possibility of misunderstanding the question. All participants reported that the questions were understandable and that there were no ambiguities; moreover regardless of native language BH. After a discussion of the results of the pilot study,

the final version of the BH FAOS was created.

### Short Form Quality of Life Questionnaire (SF-12)

SF-12 is a shortened version of the most commonly used questionnaire for assessing quality of life and subjective general health. It was often used in foot and ankle-related studies (17, 18, 20). This questionnaire is self-administered and consists of 12 questions that assess eight domains: Physical Functioning, Role-Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional, and Mental Health. Finally, the results are summarized into two components: a physical component (PCS QOL) and a mental component (MCS QOL), which were generated using standardized scoring guidelines (21). Both measures of health can be quantitatively compared, the scores for each question are converted to standard values and placed on a scale from 0 to 100 (higher score means better physical and mental health).

### Floor and ceiling effects

The presence of floor and ceiling effects may influence the reliability and validity of an instrument. Floor and ceiling effects are identified when more than 15% of participants achieve the highest or lowest possible scores on the FAOS subscales (22).

### Psychometric procedures

Psychometric procedures included checking: construct and content validity, reliability and internal consistency, as responsiveness.

### Construct validity

Construct validity was assessed by analyzing the relationship between the FAOS subscales and the two components of the SF-12 questionnaire using Spearman's correlation coefficient (r). A coefficient between 0.30 and 0.70 indicates a moderate correlation, while a coefficient below 0.30 indicates a poor correlation (18). According to previous validation studies, we hypothesized that all FAOS subscales would be moderately correlated with SF-12 PCS and weakly correlated with SF-12 MCS (17, 20). Construct validity is considered satisfactory if at least 75% of the priory hypotheses were confirmed (22).

### Content validity

Content validity is the patient's perception of the importance of each FAOS question for their condition. All participants filled out the questionnaire for all 42 questions with the following answers: 1 = not important, 2 = somewhat important, and 3 = very important. A mean score of $\geq 2$ was considered acceptable content validity (17, 18).

### Reliability

The reliability of the test implies the ability to assess a condition in the same way at two different points in time. In this study, reliability was assessed using test-retest reliability and internal consistency. The retest was conducted 48 hours after the test on the same participants (23). The intraclass correlation coefficient (ICC), two-way random effect model, and absolute agreement were used to evaluate test-retest reliability. An ICC values $\geq 0.7$

indicate acceptable reliability (17). Internal consistency was assessed by calculating Cronbach's alpha; values ≥ 0.7 were considered satisfactory (17). Bland and Altman's plots were calculated to estimate acceptance and heteroscedasticity (24).

### Responsiveness

Responsiveness means the ability of the instrument to determine changes in health status after medical intervention (17). After baseline and retest assessment, all participants were included in physical therapy treatment (Protection, Rest, Ice, Compression and Elevation protocol - PRICE, exercise therapy, and manual therapy) for four weeks.

The questionnaire was re-administered two weeks after the intervention was completed; all participants completed the intervention and completed the questionnaires. The analysis was performed with the Paired Student t-test, and Cohen's effect size was calculated, where 0.2 was considered a small effect, 0.5 a moderate effect, and ≥0.8 a large effect.

### Statistical analysis

Sample size calculation was determined with GPower software (Version 3.1.9.7) and an analytical approach (hypothesis testing). Regarding correspondence ICC for the alternative hypothesis was 0.5 (ρ H1), a null hypothesis (ρ H0=0), a 95% confidence interval, an error a of 0.05, and a desired analysis power of 95%, the program calculated that a minimum of 46 participants is required. Thus, assuming that the minimum dropout rate will be around 15%, the sample size calculation was 55 participants (25, 26). The ICC for the sample size was determined during a pilot project of understanding the prefinal version of the FAOS according to instructions of COSMIN Recommendations for sample size in reliability studies (27).

The normality of data distribution was measured by the Kolmogorov-Smirnov test. The descriptive data were presented with absolute and relative frequencies, means, and standard deviations. In all tests, statistical significance was $p<0.05$. Statistical analysis was performed using SPSS for Windows, Version 23.0 (SPSS Inc., Chicago, IL, USA).

## RESULTS

The total sample in this study consisted of 55 participants, 54.5% men and 45.5% women. The average age range of the participants was 42 years (range: 20 to 71 years). Presentation of the demographic and clinical characteristics of the participants is shown in Table 1.

**Table 1.** *Participants' characteristics*

| Variables | Total (N=55) | Male (N=30) | Female (N=25) |
|---|---|---|---|
| | N (%) | N (%) | N (%) |
| Age (*years*)* | 42.1 ± 15.2 | 43.13±14.96 | 40.92±15.71 |
| Height (*cm*) * | 179.4 ± 8.6 | 85.53±12.73 | 66.32±5.73 |
| Weight (*kg*) * | 76.8 ±13.9 | 185.43±6.11 | 172.28±4.94 |
| BMI ($kg/m^2$) * | 23.7 ±2.6 | 24.79±2.80 | 22.33±1.46 |
| Marital status | | | |
| Single | 25 (45.5) | 12 (40) | 13 (52) |
| Married | 27 (49.1) | 15 (50) | 12 (48) |
| Divorced | - (-) | - (-) | - (-) |
| Widow/er | 3 (5.5) | 3 (10) | - (-) |
| Education level | | | |
| High School | 21 (38.2) | 11 (36.7) | 10 (40) |
| College degree | 5 (9.1) | 3 (10) | 2 (8) |
| Post-graduate degree | 25 (45.5) | 12 (40) | 13 (52) |
| Doctoral Degree | 4 (7.3) | 4 (13.3) | - (-) |
| Employment status | | | |
| Student | 1 (1.8) | 1 (3.3) | - (-) |
| Employment | 44 (80) | 23 (76.7) | 21 (84) |
| Unemployment | 4 (7.3) | 2 (6.7) | 2 (8) |
| Retired | 6 (10.9) | 4 (13.3) | 2 (8) |
| Types of ankle sprains | | | |
| Lateral (inversion) | 48 (87.3) | 26 (86.7) | 22 (88) |
| Medial (eversion) | 7 (12.7) | 4 (13.3) | 3 (12) |
| Grades of sprains | | | |
| Grade I | 5 (9.1) | 2 (6.7) | 3 (12) |
| Grade II | 28 (50.9) | 15 (50) | 13 (52) |
| Grade III | 22 (40) | 13 (43.3) | 9 (36) |
| *Data are expressed as mean (standard deviation); | | | |

## Floor and ceiling effect

The overall distribution of the item's responses on the BH-FAOS was acceptable (the range of means was from 0 to 94.1). The effect of the floor and ceiling was not determined in any FAOS subscale. The minimal score was found in one participant (1.8%) in the Sport & Recreation Activities subscale.

## Time spent completing the questionnaire

All participants answered all questions. The average time to complete the questionnaire was 10.50 minutes (ranging from 5.52 to 14.10 minutes).

## Construct validity

In all subscales of the BH-FAOS, a moderately significant correlation with the physical (PCS) and mental components of the SF 12 questionnaire was determined (Table 2).

**Table 2.** *Construct validity of Bosnia and Herzegovina version of Foot and Ankle Outcome Score (XY-FAOS) and 12-item Short Form Health Survey version 2 (SF 12v2)*

| FAOS subscale | PCS | | MCS | |
|---|---|---|---|---|
| | r | P value | r | P value |
| Symptom | 0.326 | 0.015* | 0.487 | <0.001* |
| Pain | 0.404 | 0.002* | 0.563 | <0.001* |
| ADL | 0.399 | 0.033* | 0.589 | <0.001* |
| Sport & Rec | 0.331 | 0.014* | 0.476 | <0.001* |
| QOL | 0.609 | 0.017* | 0.446 | 0.001* |

Acronyms: PCS – Physical component of SF 12; MCS – Mental component of SF 12; ADL – Activity of Daily Life; Sport&Rec – Sport and Recreation Activity; QOL – Quality of Life
r (rho)– Correlation coefficient of Spearman correlation
* Significant value

## Content validity

Satisfactory importance was determined in four subscales of FAOS, except subscale Activity of Daily Living (*Table 3*).

**Table 3**. *A mean score of the importance of the Bosnia and Herzegovina version of Foot and Ankle Outcome Score (BH-FAOS) questions.*

| **FAOS subscales** | **Mean ± Standard Deviation*** |
|---|---|
| Symptom | 2.08 ± 0.65 |
| Pain | 2 ± 0.98 |
| ADL | 1.86 ± 0.94 |
| Sport & Rec | 2.61 ± 0.99 |
| QOL | 2.51 ± 0.89 |

Acronyms: ADL – Activity of Daily Life; Sport&Rec – Sport and Recreation Activity; QOL – Quality of Life
* Mean score ≥ 2 considered satisfactory importance.

## Reliability

There was no systematic difference in the BH-FAOS test/retest analysis. Moreover, excellent test/retest reliability and internal consistency were determined for each BH-FAOS subscale (*Table 4*). Bland-Altman plots of difference test/retest for each subscale of BH-FAOS suggest absolute agreement and without consistent bias (*Figure 1*).

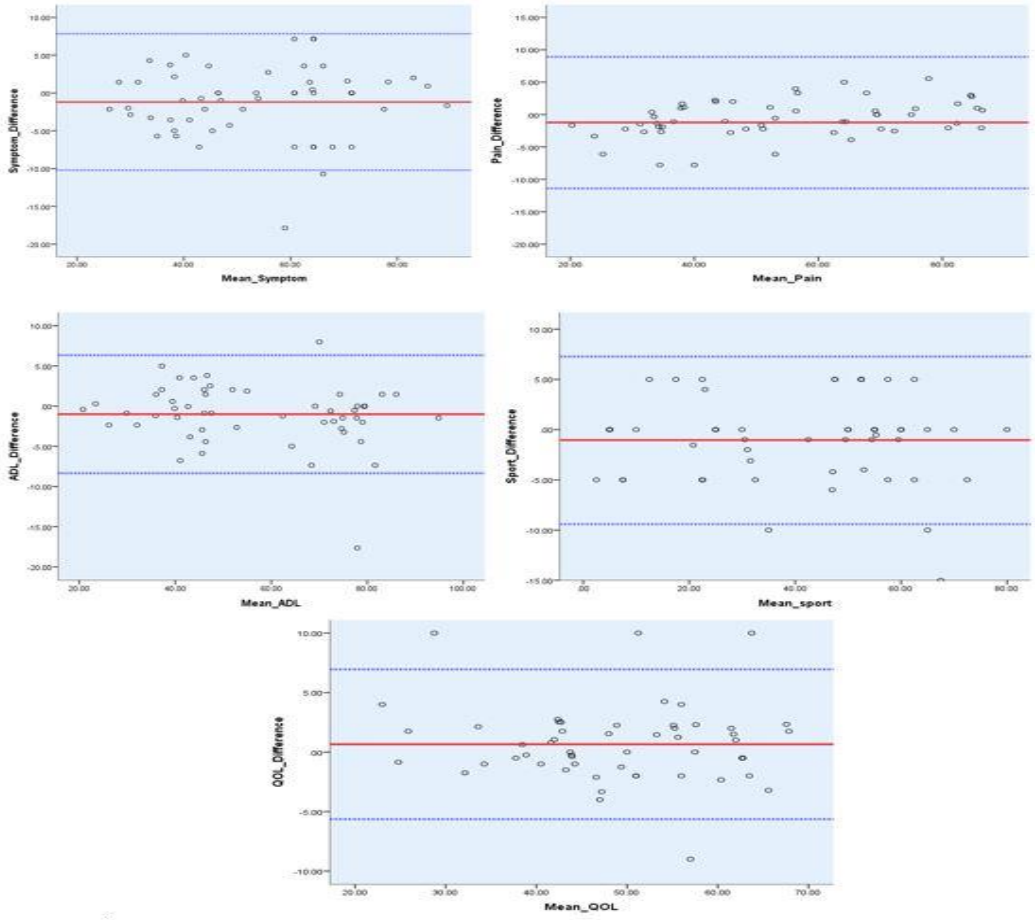


**Figure 1.** *Bland-Altman plot test and retest of the Bosnia and Herzegovina version of the Foot and Ankle Outcome Score (BH-FAOS).*

## Responsiveness

In all BH-FAOS subscales, a statistically significant difference with a large effect size was found in the comparison of BH-FAOS baseline and post-intervention scores (*Table 4*).

**Table 4.** *Reliability and the internal consistency of the XY version of the Foot and Ankle Outcome Score (XY-FAOS)*

| | **FAOS_test** N=55 | **FAOS_retest** N=55 | | | | |
|---|---|---|---|---|---|---|
| | M±SD | M±SD | MD (95%CI) | P value* | ICC (95%CI) | Cronbach alpha |
| Symptom | 53.30±16.40 | 54.50±16.22 | -1.19 (-2.43 to -1.03) | 0.061 | 0.98 (0.96 to 0.99) | 0.980 |
| Pain | 53.99±19.72 | 55.21±19.15 | -1.21 (-2.61 to 0.18) | 0.086 | 0.98 (0.97 to 0.99) | 0.982 |
| ADL | 57.10±19.06 | 58.10±19.75 | -1 (-2 to 0.01) | 0.053 | 0.99 (0.98 to 0.99) | 0.990 |
| Sport & Rec | 39.16±21.18 | 40.20±21.37 | -1.04 (-2.19 to -0.78) | 0.074 | 0.99 (0.98 to 0.99) | 0.990 |
| QOL | 49.50±11.40 | 48.83±11.67 | 0.65 (-0.21 to 1.52) | 0.136 | 0.98 (0.96 to 0.99) | 0.980 |

Acronyms: ADL – Activity Daily Living; Sport & Rec – Sport and Recreation Activity; QOL – Quality of Life; M±SD – Mean±Standard Deviation; MD (95%CI) - Mean Difference (95% Confidence Interval); ICC (95% CI) - Interclass Correlation Coefficient (95% Confidence Interval);
*Paired Student t-test: statistical significance p<0.05

## DISCUSSION

The results of this study indicated that the BH version of the FAOS is a valid and reliable questionnaire for assessing symptoms and functional limitations in patients with ankle sprains. Moreover, the established high values of the psychometric characteristics of the BH-FAOS suggest that this instrument was properly adapted for the BH population with an ankle sprain.

Regarding construct validity, following the results of available similar studies, the hypothesis was that the FAOS subscales would have a moderate correlation with the PCS component of the SF-12 and a weak correlation with the MCS component of the SF-12 (15, 17, 20). In our study we found a moderate positive significant correlation with both components of the SF-12, thus only partially confirming the hypothesis. A moderate correlation with both components of the SF-12 questionnaire was determined in the validation study by Joshi et al (18). Finally, our results suggest that the BH-FAOS and SF-12 can be used together and that they will provide similar results.

The importance of the FAOS questions from the patient's perspective is also an essential step for the validity of the instrument. In our study, all questions within the BH-FAOS subscales were of acceptable importance, except for the ADL subscale. A possible reason may be that the original FAOS was developed from KOOS and that some issues related to functional limitations in everyday life are more related to knee and osteoarthritis disorders, as stated by Whittaker et al, 2020 (28).

The consistency of the BH-FAOS was very high (ICC and Cronbach values range from 0.98 to 0.99). The highest values of both measures were determined for the ADL and Sport&Rec subscales, and a significant difference was found in the two subscales in test-retest analysis. Compared to other FAOS validation studies, the reliability and internal consistency measures in our study are somewhat higher. However, in all studies, the determined values indicate very high to excellent reliability of FAOS. A possible reason for the slight diversity in the determined values of ICC and Cronbach's alpha in our and similar studies can certainly be the diversity of foot and ankle disorders and injuries. Our study included participants with ankle sprains, while other studies included a variety of disorders, from Acquired Flatfoot Deformity, Infracalcaneal Heel Pain, Hallux Rigidus and Valgus, and others (16-18, 20, 29). In addition, Bland-Altman's analysis showed absolute agreement and a lack of consistent bias in BH-FAOS reliability.

Also, the BH-FAOS is useful for evaluating the effectiveness of ankle sprain treatment. In this study, the physical therapy intervention consisted of the PRICE protocol (first week), immobilization and manual therapy (second week), and exercise therapy and manual therapy (third and fourth week). The difference of determined values in all subscales had a large significant effect size. The usefulness of FAOS in determining the prognostic values of clinical and anthropometric parameters after physical therapy intervention in lateral ankle sprains was confirmed in the

study by Khazaei et al (30). Also, the study by Goulart Neto et al confirmed the validity of FAOS and FAAM in assessing postural control and muscle strength in CAI, highlighting the need for future validation studies for determining the monitor the efficacy of rehabilitation and postoperative care of both instruments (31).

Despite some stated shortcomings in the literature review and studies of poor quality, recent systematic reviews stated that FAOS is one of the two most commonly used outcome measures for foot and ankle pathology and it is in first place in the bibliometric weighted average of the impact factors of included original publications (13, 32, 33). This is the main reason for the choice of this outcome instrument for the validation purpose in our population.

The strengths of this study include a robust psychometric evaluation, as it comprehensively assesses four key psychometric properties. The FAOS demonstrated high reliability, indicating consistent and reproducible results. By correlating the FAOS with the widely used SF-12 questionnaire, the study strengthens its construct validity findings, linking FAOS scores with both physical and mental health outcomes. The inclusion of responsiveness testing after physical therapy highlights the FAOS's sensitivity to changes in patient condition, enhancing its clinical applicability. Additionally, the study demonstrates that the BH-FAOS is both valid and reliable, making it suitable for use in clinical practice and research within the targeted patient population. These strengths contribute to the reliability, validity, and practical utility of the BH-FAOS for assessing outcomes in patients with ankle sprains.

This study had several limitations. We did not use objective outcome measurements, such as the range of motion in the foot and ankle. Also, the findings of this study may not be generalizable for children and teenagers since these age groups were not included in our sample. Moreover, we did not have a follow-up period (up to a year) to more clearly determine responsiveness. A limitation may also be the sample size, regarding the calculation. According to the COSMIN Study Design checklist for Patient-reported outcome measurement instruments, the sample size in this study falls into the category „adequate“ for assessing construct validity, reliability, criterion validity and construct validity. To have the highest ranked category (very good), the sample size needs to be ≥100. However, our sample size falls into the „very good“ category in terms of responsiveness (34). Finally, the limitation is the influence of the timing of the second survey in the assessment of responsiveness.

## CONCLUSION

This study has translated and validated the BH version of FAOS with acceptable construct and content validity, reliability, and responsiveness. The use of this questionnaire as an outcome measure is acceptable for clinical and scientific purposes in ankle sprain injuries.

Future studies are needed to establish psychometric properties for patients with different foot and ankle problems.

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# PRIJEVOD, MEĐUKULTURALNA PRILAGODBA I EVALUACIJA PSIHOMETRIJSKIH SVOJSTAVA BOSANSKOHERCEGOVAČKE VERZIJE UPITNIKA ZA PROCJENU ISHODA STOPALA I GLEŽNJA KOD PACIJENATA S UGANUĆEM GLEŽNJA; STUDIJA PRESJEKA

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## SAŽETAK

Cilj: Prilagoditi i potvrditi bosanskohercegovačku verziju upitnika procjene ishoda stopala i gležnja (FAOS) kod pacijenata s uganućem gležnja.

Metode: Uključeno je ukupno 55 bolesnika s uganućem gležnja. Procijenjene su četiri psihometrijske mjere: konstruktivna valjanost (korelacija FAOS-a i upitnika o zdravlju – SF12), sadržajna valjanost (pacijentova percepcija važnosti FAOS pitanja), pouzdanost (test-retest i unutarnja dosljednost, Bland-Altmanova analiza) i odgovornost (nakon intervencije fizioterapije).

Rezultati: Utvrđena je zadovoljavajuća konstruktivna valjanost; sve podljestvice FAOS bile su u umjerenoj korelaciji ($r > 0,3$) s komponentama fizičkog i mentalnog zdravlja SF-12 ($r > 0,30$). Također, sve FAOS podljestvice pokazale su izvrsnu pouzdanost (vrijednosti koeficijenta međuklasne korelacije (ICC) >0,90; Cronbachove alfa vrijednosti ≥0,98).

Zaključak: BiH verzija FAOS-a je pouzdan i validan instrument za procjenu ishoda kod pacijenata sa uganućem gležnja. Izvrsna pouzdanost i konstruktivna valjanost čine ga prikladnim za znanstvene i kliničke svrhe.

**Ključne riječi:** FAOS, PROM, uganuće gležnja, valjanost, pouzdanost

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# THE RELATIONSHIP OF THE LEVEL OF EDUCATION OF MIDWIVES AND NURSES WITH THE OPINION ON THE APPLICATION OF MIDWIFE/NURSING DOCUMENTATION

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## ABSTRACT

Introduction: Nursing documentation is a set of documents that a nurse fills in or records in them information about her actions during the entire care process, with the purpose of systematic monitoring of the state of the individual, family and community, planning, evaluation and control of what has been done. Nurses/technicians and midwives are becoming more aware of the need for documentation because it represents stability and security on the way to developing the profile of professional titles into recognized professions.

Aim: The main objective of this research is to determine the existence of a connection between the level of education of nurses / midwives and the opinion on the application of existing documentation.

Materials and methods: The cross-sectional study was conducted at the beginning of 2024 in the County Hospital “Dr. fra Mihovil Sučić” Livno, Livno Health Center, Tomislavgrad Health Center and Mostar University Clinical Hospital. The research was conducted on a sample of 80 participants. For the purposes of the research, a survey questionnaire was used, taken from the author of the paper “Attitudes of nurses and midwives about electronic nursing documentation in perinatological practice”, Car D., the use of which was requested and obtained, and adapted for the needs of this paper.

Results: The results of this study did not establish a statistically significant difference in opinion regarding the application of existing documentation in nursing and midwifery with regard to the level of education. Nurses/technicians and midwives with a bachelor’s degree believe that nursing documentation is better managed by nurses/technicians and midwives with a higher level of education, and that nurses/technicians and midwives with high school education attach too little importance to nursing documentation.

Conclusion: Healthcare professionals consider nursing and midwifery documentation to be important for overall care. There is no significant difference in opinion regarding the application of existing documentation in nursing and midwifery, based on the level of education.

**Keywords:** documentation, midwifery, nursing, satisfaction, education

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## INTRODUCTION

According to the Law on Nursing and Midwifery of the Federation of Bosnia and Herzegovina from 2013, a nurse, or midwife, is obliged to record all performed procedures in the nursing, or midwifery documentation, which is part of the medical documentation, for each individual patient, at all levels of health care (1). The role of nursing documentation is also recognized in nursing management, where it serves as an indicator of the quality of health care (2). Gossen et al. as early as 1998, they concluded that the documentation is a valuable instrument for creating a patient profile by nursing diagnostic groups, but also for insight into health care costs, etc. (3). Nurses (OB Dubrovnik) understand the need to keep documentation, but most still consider it an unimportant part of their job, and that it takes away the time they need for the patient (4). Manual documentation management increases the time required for documentation, and they believe computerization would ensure a faster and simpler flow of information (5, 6). The health workers of the Osijek hospital also consider keeping documentation in nursing a waste of time, significantly more so those with a lower level of education (7). The purpose of midwifery documentation is complex and multi-functional, involving much more than recording the clinical and legal details of a patient's care. Midwifery documentation has an impact on the positive experiences of patients with midwifery care, supports the role of the midwife, strengthens cooperation between healthcare professionals and contributes to organizational processes and research (8). However, surveyed midwives in an Australian study overestimate the time spent on documentation and feel frustrated, and suggest revising existing documentation with the aim of creating more time for direct patient care (9). Similar views are expressed by midwives from Uganda, who support individualized midwifery care, but still see documentation as a burden in their daily work (10).

By reviewing the available scientific databases, one research paper was found on midwives' opinions and attitudes about maintaining midwifery documentation. Of all those surveyed, midwifery bachelors attach the least importance to electronic nursing documentation in their work. The majority of respondents, of all educational profiles, consider the current medical history and health care plan insufficiently applicable in everyday perinatological practice, and advocate changes in certain segments of the documentation (11). The goal of this research was to determine the existence of a connection between the degree of education of nurses / midwives and the opinion on the application of existing documentation, and to examine opinions on the benefits of the application of existing documentation in perinatological practice.

## MATERIALS AND METHODS

The cross-sectional study was conducted at the beginning of 2024 in the County Hospital "Dr. Fra Mihovil Sučić" Livno, Livno Health Center, Tomislavgrad Health Center and Mostar University Clinical Hospital.

## Respondents

The random sample consisted of 80 participants (N=80). Incompletely filled questionnaires were excluded from the research.

## Research methods

The survey questionnaire taken from the research "Attitudes of nurses and midwives about electronic nursing documentation in perinatological practice" by the author Car D., whose consent was obtained, and adapted for the needs of this paper, was used. The first part of the questionnaire was related to general sociodemographic data, while the rest was made up of statements related to the everyday use of nursing and midwifery documentation. Participants had the opportunity in the last question to indicate what would need to be included in nursing/midwifery documentation, to make it specific to perinatology practice (11). The research was conducted through a written questionnaire in the County Hospital "Dr. Fra Mihovil Sučić" in Livno and via Google Form questionnaire in other institutions.

## Ethics approval of research

The research was reported to the competent ethics committee, and approval was obtained for the same.

## Statistical analysis

The collected data were processed using the methods of descriptive and inferential statistics. The value of p<0.05 was used as the level of statistical significance. The software system IBM SPSS Statistics 25 and Microsoft Excel 2016 were used for statistical data analysis.

## Sample description

Nurses/technicians and midwives employed in: Mostar University Clinical Hospital, County Hospital “Dr. Fra Mihovil Sučić” Livno, Livno Health Center, Tomislavgrad Health Center took part in the research, and the number was 80 respondents. Out of 80 participants, 21 are male, and the remaining 59 are female participants. 28 of them (3.5%) are employed in Livno County Hospital, 44 (55.5%) in Mostar University Clinical Hospital; five participants (6.25%) are employed at the Livno Health Center and three participants (3.75%) are employed at the Tomislavgrad Health Center. The minimum age in this sample was 23 years, and the maximum age was 56 years. The average age, expressed as the arithmetic mean, is M=31.21 (SD=8.11) years, and the median age is C=28.0 (Q=3.5) years. Regarding years of service, the smallest number of years in this sample is one year, and the largest number of years is 35 years. The average number of years of service expressed by the arithmetic mean is M=8.59 (SD=8.16), and expressed by the median is C=6.0 (Q=3.5). In terms of educational status, 17 participants (21.3%) state the category of completed secondary health care education as their professional qualification, 12 of them (15.0%) state the category of midwife/midwife assistant, 16 participants (20.0%) have a bachelor's degree in nursing, 18 (22.5 %) have a bachelor's degree in midwifery and 17 participants (21.3 %) have a master's degree in nursing or a graduate medical technician.

## RESULTS

The analysis of data on satisfaction with the use of nursing documentation is shown in Table 1, and the results of testing the significance of the difference in responses are shown in Table 2.

**Table 1.** *Data of descriptive statistics on claims about nursing documentation on the entire sample of participants (N=80)*

| | | | *N* | *%* |
|---|---|---|---|---|
| 1. | I consider nursing documentation extremely important for overall nursing care. | Not at all. | 0 | 0.0 |
| | | Partly no. | 0 | 0.0 |
| | | Neither yes nor no. | 10 | 12.5 |
| | | Partly yes. | 39 | 48.8 |
| | | Totally yes. | 31 | 38.8 |
| 2. | I believe that nurses and midwives with a higher level of education manage nursing documentation better. | Not at all. | 5 | 6.3 |
| | | Partly no. | 8 | 10.0 |
| | | Neither yes nor no. | 29 | 36.3 |
| | | Partly yes. | 23 | 28.7 |
| | | Totally yes. | 15 | 18.8 |
| 3. | I believe that nurses and midwives with completed secondary healt care education attach too little importance to nursing documentation. | Not at all. | 8 | 10.0 |
| | | Partly no. | 19 | 23.8 |
| | | Neither yes nor no. | 34 | 42.5 |
| | | Partly yes. | 10 | 12.5 |
| | | Totally yes. | 9 | 11.3 |
| 4. | I believe that the current nursing anamnesis documentation in the hospital system is appropriate for the department in which I work. | Not at all. | 8 | 10.0 |
| | | Partly no. | 10 | 12.5 |
| | | Neither yes nor no. | 20 | 25.0 |
| | | Partly yes. | 30 | 37.5 |
| | | Totally yes. | 12 | 15.0 |

**Table 2**. *Testing the significance of the difference in average responses to claims about nursing documentation with regard to the category of education level, Kruskal-Wallis H test (N=80)*

| | Average rank | | | | | |
|---|---|---|---|---|---|---|
| | completed secondary healt care education ($n_1$=29) | Baccalaureate (n=34) | Master (n=17) | *H* | *df* | *p* |
| I consider nursing documentation extremely important for overall nursing care. | 36.16 | 42.66 | 43.59 | 1.95 | 2 | 0.38 |
| I believe that nurses and midwives with a higher level of education manage nursing documentation better. | 31.83 | 48.40 | 39.50 | 8.68 | 2 | 0.01 |
| I believe that nurses and midwives with completed secondary healt care education attach too little importance to nursing documentation. | 31.36 | 47.84 | 41.41 | 8.73 | 2 | 0.01 |
| I believe that the current nursing anamnesis documentation in the hospital system is appropriate for the department in which I work. | 41.67 | 34.71 | 50.09 | 6.58 | 2 | 0.06 |

Legend: *H* - resultate on Kruskal.Wallis H test;*df* –degrease of freedom ;*p*-statistical importance

A statistically significant difference was found in the levels of average responses to the following statements: "*I believe that nurses and midwives with a higher level of education manage nursing documentation better*" and "*I believe that nurses and midwives with a high school education attach too little importance to nursing documentation*". Those with a baccalaureate degree agree the most with both statements, and those with a secondary health care education the least.

On the other two statements ("*I consider nursing documentation extremely important for overall nursing care*" and "*I believe that the current nursing history in the hospital system is appropriate for the department where I work*"), no statistically significant difference was found with regard to the level of education, which indicates that that the participants of different education profiles agree with the stated claims to the same extent.

Table 3 shows the answers to the questions asked only to midwives and nurses working in the gynecology and childbirth department (N=31).

**Table 3.** *Descriptive statistics data on claims about nursing documentation on part of the sample of midwives and nurses working in the department of women's diseases and childbirth (N=31)*

| | | | *N* | *%* |
|---|---|---|---|---|
| 1. | I believe that all segments of the current nursing anamnesis are appropriate for planning the health care of pregnant women and women in labor. | Not at all. | 5 | 16.1 |
| | | Partly no. | 9 | 29.0 |
| | | Neither yes nor no. | 9 | 29.0 |
| | | Partly yes. | 6 | 19.4 |
| | | Totally yes. | 2 | 6.5 |
| 2. | I believe that the health care plan is essential for perinatological practice. | Not at all. | 0 | 0.0 |
| | | Partly no. | 1 | 3.2 |
| | | Neither yes nor no. | 6 | 19.4 |
| | | Partly yes. | 12 | 38.7 |
| | | Totally yes. | 12 | 38.7 |
| 3. | I believe that setting nursing diagnoses and interventions is essential for quality health care in perinatology. | Not at all. | 0 | 0.0 |
| | | Partly no. | 0 | 0.0 |
| | | Neither yes nor no. | 8 | 25.8 |
| | | Partly yes. | 15 | 48.4 |
| | | Totally yes. | 8 | 25.8 |
| 4. | I believe that current nursing diagnoses (eg reduced ability to take care of oneself) are not applicable in perinatological practice. | Not at all. | 0 | 0.0 |
| | | Partly no. | 4 | 12.9 |
| | | Neither yes nor no. | 13 | 41.9 |
| | | Partly yes. | 11 | 35.5 |
| | | Totally yes. | 3 | 9.7 |
| 5. | I believe that more information about the course of pregnancy is needed in the nursing anamnesis. | Not at all. | 0 | 0.0 |
| | | Partly no. | 1 | 3.2 |
| | | Neither yes nor no. | 4 | 12.9 |
| | | Partly yes. | 12 | 38.7 |
| | | Totally yes. | 14 | 45.2 |
| 6. | I believe that there is a need to define nursing diagnoses and interventions, which are applicable for pregnant women and women in labor. | Not at all. | 0 | 0.0 |
| | | Partly no. | 0 | 0.0 |
| | | Neither yes nor no. | 4 | 12.9 |
| | | Partly yes. | 14 | 45.2 |
| | | Totally yes. | 13 | 41.9 |

## DISCUSSION

The examined health professionals, mostly employees of the Mostar University Clinical Hospital and the County Hospital "Dr. Fra Mihovil Sučić" Livno, consider nursing and midwifery documentation important for overall care. There is no significant difference in opinion regarding the application of existing documentation in nursing and midwifery, considering the

level of education. Participants with an academic level of education, primarily bachelor's degree holders, believe that the academic level affects better documentation management and that their colleagues with secondary education do not attach enough importance to documentation, but these claims can be contested on the basis of the absence of a significant difference in opinion about the importance of documentation. There were 50 nurses/technicians and 30 midwives in our examined sample. An equal number of participants (N=78) is also found in Car D.'s research (2021), whose questionnaire was taken over for the purposes of our research, and the results showed that documentation is considered extremely important by masters of nursing, i.e. graduated nurses/technicians, and electronic documentation is considered the least important by midwifery bachelors (11). Our findings are not consistent with these results, given that our participants with secondary education show awareness of the importance of documentation. The younger age of the participants (31.21 years) and the average length of service (8.59 years) can be considered as positive predictors of the attitude about the importance of documentation in this research, but further research on a larger sample is needed to confirm this.

Also, it is indicative that almost half of our participants consider documentation to be partially essential for nursing care. Are they unsatisfied with the content of the existing documentation, or do they think that direct activities around the patient play a more significant role in the quality of care? However, given that the vast majority of participants have an academic level of education, there should be an awareness of the power of documentation as a communication tool between staff and patients, as well as in the team. Only 15% of the participants consider the content of the medical anamnesis form to be completely appropriate, while more than a third is partially convinced of its adequacy, so it is possible that the opinion about an inappropriate medical anamnesis form can be connected with an uncertain attitude about the importance of documentation for care, considering that care planning begins with quality nursing / midwifery anamnesis.

In 2019, a study was conducted in hospitals in Henan province (China) on the relationship between the education of nurses and midwives and the opinion about documentation. Half of the respondents considered high-quality archiving of documentation to be important. The authors conclude that a higher level of education is still not a strong enough factor, and that younger age, less work experience and a significant workload can lead to a decrease in the quality of nursing documentation. The need to continuously improve nurses' awareness of the importance and legal significance of documents was pointed out (12).

In this research, there is no significant difference in satisfaction with the use of documentation between nurses/technicians and midwives. Part of the sample in this research was made up of participants - midwives and nurses who work in the department related to women's diseases and childbirth in Mostar University Clinical Hospital and County Hospital "Dr. Fra Mihovil Sučić" Livno. The answers to the claims about the significance and benefits of the existing documentation are more than indicative. Namely, only 6.5%

of the participants think that the anamnesis is appropriate for care planning, and the vast majority are undecided or partially agree. Partial agreement / disagreement is more in favor of disagreement, so the opinion is clearly expressed that the current pattern of anamnesis is not expedient. Also, almost half of the participants believe that more information about the course of pregnancy is needed in the nursing anamnesis, and with this statement the participants were the most unanimous in their opinion compared to the other issues. There is no satisfaction with the use of existing nursing diagnoses either, i.e. almost half think that it is necessary to define better nursing diagnoses and interventions so that they are applicable for pregnant women and mothers. No statistically significant difference was found between the participants with secondary school education and higher education in the levels of agreement with the stated statements, i.e. dissatisfaction with the existing documentation is present regardless of the level and profile of education.

There is no satisfaction among nurses and midwives in the Republic of Croatia. According to Car D's research, nurses and midwives least agree with the statements that the current nursing history in the hospital IT system is suitable for perinatology departments, that all segments of the current nursing history are suitable for planning the health care of pregnant women and new mothers, i.e. that all segments of the categorization are applicable in perinatological practice (assessment of independence, physical activity, risk of falling, state of consciousness, risk of pressure ulcers, vital signs, communication, specific, diagnostic and therapeutic procedures in health care and education). They give these articles an average score of up to 2.50, which indicates that they do not agree with the statements, and it can be concluded that nurses and midwives in the Republic of Croatia also believe that the current nursing history and categorization of patients are not appropriate for perinatological practice (11). No research was found in the Federation of Bosnia and Herzegovina on the views of midwives on maintaining midwifery documentation. Although the Dutch system is cited as one of the best systems in midwifery, there are also problems with insufficient data in midwifery documentation related to the course of pregnancy and childbirth. In the last decade, a lot of effort has been invested in making the so-called "Perinatological register", i.e. a program that is used in all hospitals with perinatology activities, and contains data on the condition of pregnant women, mothers in labor and newborns. In 2016, the above-mentioned program was introduced in all perinatology departments, which monitors the conditions of pregnant women, mothers in labor and newborns. This computer program was created at the request of the Dutch Association of Obstetrical Nurses (13, 14).

One of the possible shortcomings of this research is the design of the sample. In the methodology, it was stated that the participants will be from two health centers from the area of Hercegbosna County. However, out of a total of 80, there are only a few employees from health centers, and this information in itself has no significance for analysis or reaching any conclusion. The reason for this is the lack

of interest among the employees contacted in the health centers about completing the survey in a certain period of time. There was also a difficulty with part of the midwifery masters sample. In the Federation of Bosnia and Herzegovina, only the Faculty of Health Studies at the University of Mostar has a diploma course in midwifery, the education of which is conditioned and harmonized by EU Directive 2005/36/EC (15). The lack of research on the connection between the education of nurses / midwives and the opinion on the management of nursing documentation in the Republic of Croatia and Bosnia and Herzegovina confirms the need for further research on this topic, and the contribution of the results obtained from this research can be reflected in this. Also, the found dissatisfaction of nurses / midwives regarding the application of existing documentation requires new research hypotheses on this research topic in order to obtain more reliable results and confirmation of the need for professional reflection on the (non) existence of deficiencies in this documentation and perhaps the development of guidelines for future documents. As part of the research, the hypothesis about the existence of a difference in satisfaction with nursing documentation between the nurses/technicians of the County Hospital "Dr. Fra Mihovil Sučić" Livno and University Clinical Hospital Mostar. Nurses / technicians and midwives of the University Clinical Hospital Mostar show a significantly more positive attitude towards nursing documentation, i.e. understanding the importance of nursing documentation and setting nursing diagnoses and interventions. In that line, the same employees believe that nurses and midwives with a higher level of education manage nursing documentation better, and that nurses and midwives with a high school education attach too little importance to nursing documentation.

Midwives and nurses/technicians of all education profiles realize the importance of setting nursing/midwifery diagnoses in perinatology, but do not consider the documentation used in the perinatology practice departments in which they work to be sufficient due to the lack of data on previous pregnancies and the course of pregnancy itself. For example, the Nursing history regulated by the Ordinance on the form and content of basic medical documentation of the law on records in the field of health of the Federal Ministry of Health (16), which is used in the County Hospital "Dr. Fra Mihovil Sučić" Livno and University Clinical Hospital Mostar, does not contain a single question related to perinatology. For example, the Republic of Croatia, at the suggestion of the Croatian Chamber of Midwives, regulated and unified midwifery documentation with the Midwifery Act, thereby raising awareness of the importance of the midwifery profession (17). In the Federation of Bosnia and Herzegovina, there is no Chamber of Midwives at the federal level, which makes any efforts to achieve documentation standardization difficult, and to strengthen the development of midwifery as a profession.

The last survey question in this research was open-ended, where the nurses and midwives employed in the wards for women's diseases and childbirth were left with space to state questions that would be important as part of the midwifery anamnesis (and which are not found in the existing nursing anamnesis). By reviewing

the responses (which are numerous and of high quality), we can first of all conclude that there is dissatisfaction with the existing documentation, and that the same shows, in fact, the interest of midwives in the development of their own profession and, perhaps, awareness of the complexity of providing care for two living beings.

Only complete, orderly and clearly managed documentation can provide relevant data and thus ensure the continuity of midwifery care, but also serve as a research resource for the purpose of developing the profession (18, 19).

In order to achieve all of the above, midwives must in the future be more aware of their own professional identity, values, and responsibilities, and work and act towards the improvement of midwifery as one of the most sensitive and courageous professions.

## CONCLUSION

The results of this study did not reveal a statistically significant difference in opinion regarding the application of existing documentation in nursing and midwifery based on the level of education. Only 15% of participants considered the content of the anamnesis form to be completely appropriate, while more than a third where partially convinced of its appropriateness. No statistically significant difference was found between participants with secondary education and higher education in the levels of agreement with the statements made, i.e. dissatisfaction with existing documentation is present regardless of the level and profile of education. A more positive attitude towards nursing documentation is significantly expressed by nurses/technicians and midwives at the University Clinical Hospital Mostar.

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# POVEZANOST STUPNJA OBRAZOVANJA PRIMALJA I MEDICINSKIH SESTARA S MIŠLJENJEM O PRIMJENI PRIMALJSKE / SESTRINSKE DOKUMENTACIJE

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## SAŽETAK

Uvod: Sestrinska dokumentacija predstavlja skup dokumenata koje medicinska sestra ispunjava ili u njih zapisuje podatke o svojim postupcima tijekom cjelokupnog procesa skrbi, sa svrhom sustavnog praćenja stanja pojedinca, obitelji i zajednice, planiranja, vrednovanja i kontrole učinjenoga. Medicinske sestre / tehničari i primalje postaju svjesniji potrebe za dokumentiranjem jer ono predstavlja postojanost i sigurnost na putu razvoja profila stručnih zvanja u priznate profesije.

Cilj: utvrditi postojanje povezanosti stupnja obrazovanja medicinskih sestara / primalja s mišljenjem o primjeni postojeće dokumentacije.

Ispitanici i metode: Presječno istraživanje se provelo početkom 2024. godine u Županijskoj bolnici „Dr. Fra Mihovil Sučić“ Livno, Domu zdravlja Livno, Domu zdravlja Tomislavgrad i Sveučilišnoj kliničkoj bolnici Mostar. Istraživanje je provedeno na uzorku od 80 sudionika. Korišten je anketni upitnik preuzet od autorice rada „Stavovi medicinskih sestara i primalja o elektroničkoj sestrinskoj dokumentaciji u perinatološkoj praksi Car D., čije je korištenje zatraženo i dobivena.

Rezultati: Nije nađena značajna razlika u mišljenju oko primjene postojeće dokumentacije u sestrinstvu i primaljstvu obzirom na stupanj obrazovanja. Medicinske sestre / tehničari i primalje sa bakalaureatom smatraju da sestrinsku dokumentaciju bolje vode medicinske sestre / tehničari i primalje sa višim stupnjem obrazovanja, te da medicinske sestre / tehničari i primalje sa srednjoškolskim obrazovanjem pridaju premalo važnosti sestrinskoj dokumentaciji.

Zaključak: Zdravstveni djelatnici smatraju sestrinsku i primaljsku dokumentaciju značajnom za cjelokupnu skrb. Nema značajne razlike u mišljenju oko primjene postojeće dokumentacije u sestrinstvu i primaljstvu obzirom na stupanj obrazovanja.

**Ključne riječi**: dokumentacija, primaljstvo, sestrinstvo, zadovoljstvo, obrazovanje

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# THE INCIDENCE OF HEPATITIS B OVER A TEN-YEAR PERIOD IN THE HERZEGOVINA-NERETVA AND SPLIT-DALMATIA COUNTIES

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## ABSTRACT

Introduction: Hepatitis B is a viral infection of the liver that can present as both an acute and chronic disease, caused by the hepatitis B virus (HBV). Despite the availability of an effective vaccine and antiviral therapies capable of suppressing viral replication , hepatitis B remains a significant public health concern. The aim of the study is to collect, statistically analyze, and compare data on age, gender, and the number of hepatitis B cases in the Herzegovina-Neretva (HNC) and Split-Dalmatia (SDC) Counties.

Participants and methods: In this retrospective study, data were collected on the number of inhabitants and the number of registered patients with hepatitis B in the areas of these two counties, as well as demographic data of patients (age, gender) for the period from January 1, 2014, to December 31, 2024.

Results: In HNC region, 11 individuals with hepatitis B were registered during the study period, with nearly equal numbers of women and men. The affected men were significantly younger than the women ($p<0.05$). In the SDC, 55 individuals with hepatitis B infection were registered during the same period, with significantly more men than women ($p<0.05$), while there was no statistically significant difference in the age of the patients ($p>0.05$). The average annual rate of reported hepatitis B infections in the observed period in the HNC was 0.42 %000, while in the SDC, it was 0.96 %000,. The overall notification rate of cases in the SDC was 12.21 %000,, significantly higher than in the HNC, where it was 4,66 %000, ($p<0.05$).

Conclusion: It was determined that both counties have a low incidence rate of hepatitis B. The epidemiological data on hepatitis B obtained in this study are important for guiding prevention and treatment of the disease in the areas studied and contribute to one of the World Health Organization (WHO) goals, which is the elimination of hepatitis worldwide by 2030.

**Keywords**: hepatitis B, incidence, elimination, Split-Dalmatia County, Herzegovina-Neretva County.

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## INTRODUCTION

Viral hepatitis B is an acute and chronic liver disease caused by the hepatitis B virus (HBV), which remains a public health concern despite the availability of an effective vaccine and antiviral drugs capable of suppressing viral replication. It is estimated that there are over 250 milion people worldwide with chronic hepatitis B, and in 2022, 1.1 milion people died from the disease, primarily due to decompensated cirrhosis or hepatocellular carcinoma (HCC) (1-12). It is estimated that 3.6 million people in the Europa Union (EU) are living with chronic infection, and the prevalence and incidence increase from north to south and from west to east across Europe (1-5).

Croatia is classified as a country with a low prevalence of HBV infection. The prevalence of chronic hepatitis B in adult population is 0.7%, which corresponds to aproximately 25,000 HBV carriers, many of whom remain undiagnosed. Half of them typically have active disease and are candidates for treatment. The prevalence of HBV infection is lower than 0.1% among voluntary blood donors, 0.2% among pregnant women, and higher in at-risk groups, with 3% among drug users and 5 % among HIV-positive individuals. After the initiation of screening of pregnant women and vaccination against hepatitis B in 1999, the prevalence of this disease significantly decreased in the young population (6,7).

HBV is most commonly transmitted sexually, but it can also be transmitted parenterally/percutaneously (trough blood or plasma transfusions, as well as contaminated donated sperm and organs, insufficiently sterilized needles and instruments, and other items that have been in contact with the blood of an infected person or virus carrier). There is also vertical transmission, where HBV is transmitted from mother to child. The spread of HBV infection is also influenced by close contact with an infected person (saliva, blood, sweat, etc.), and adults are more likely to develop the disease than children (8-12).

### Treatment of hepatitis B

The main goal of hepatitis B treatment is to stop the replication of the virus and reduce the inflammatory activity of the disease, which significantly reduces the risk of developing fibrosis, cirrhosis and HCC.
The therapy also improves the patients quality of life.

HBsAg negativity occurs very rarely, only in 1-2% of cases (in HBeAg negative patients) and up to 10% (in HBeAg positive patients) over 5 years of treatment. This usually represents a functional cure, and in such cases, therapy is discontinued. In all other cases, therapy is usually permanent (1,13).

Before deciding on treatment, it is necessary to assess the disease activity. We distinguish between chronic hepatitis B, which mostly includes patients with a clear indication for treatment, and chronic HBV infection, in which treatment is indicated only in certain cases, but monitoring is always necessary (14).

The drugs used in HBV infection are nucleoside/nucleotide analogues (NAs)

with strong antiviral effects and a high barrier to resistance development. According to the guidelines of the Reference Center for Diagnostics and Treatment of Viral Hepatitis in the Republic of Croatia, the first-choice therapy includes tenofovir disoproxil (TDF) and entecavir (ETV), while tenofovir alafenamide (TAF) is recommended for certain indications.

These drugs inhibit the synthesis of HBV DNA outside the hepatocyte nucleus; therefore, therapy is usually permanent, as HBV replication resumes upon discontinuation (14,15).

TDF has the best barrier to the development of resistance, which practically never occurs during therapy. It can be used during pregnancy and in decompensated cirrhosis.

It is not suitable for patients with severe osteoporosis. ETV can be given to children older than two years and in cases of decompensated cirrhosis, but it is not recommended for pregnant women.

TAF has lower renal toxicity and is therefore reserved for patients with chronic HBV infection who have renal insufficiency or osteoporosis, and who cannot receive ETV due to prior resistance to ETV or lamivudine (LAM). Initiation of therapy with LAM is no longer recommended due to the rapid development of resistance. Only patients who have been on long-term LAM therapy with sustained viral suppression and no adverse effects may continue treatment until resistance emerges. After five years of treatment, the development of viral resistance to LAM reaches up to 50%. Adefovir and telbivudine are no longer used frequently due to their lower efficacy compared to the previously mentioned drugs (1,3,13–15).

## Prevention and control

In addition to drug therapy, prophylactic measures should be implemented in infected individuals (1,16,17).

For the purpose of prophylaxis and preventing the spread of hepatitis B, general and special protection measures should be implemented. General measures include the application of all available personal protective procedures to prevent contact with infectious materials (blood, saliva, semen), as well as the implementation and continuous monitoring of the quality of disinfection and sterilization of medical instruments, proper disposal of infectious waste, and blood testing of all blood, tissue, and organ donors (1,18,19).

Special protection measures include pre-exposure and post-exposure immunoprophylaxis.

Pre-exposure prophylaxis is carried out through vaccination. In the Republic of Croatia, vaccination of at-risk groups began in 1994; since 1999, children from 12 years of age have been vaccinated, and since 2007, all newborns have been vaccinated (1-3, 5-8, 16-19).

Post-exposure prophylaxis should be administered to newborns of HBsAg-positive mothers in the first few hours after delivery, after a single exposure to the HBV virus (stabbing incident) and in persons who had sexual contact with infected persons (1,5,20-23).

In the prevention of HBV infection and the care of patients with hepatitis B, nurses,

technicians, and other healthcare professionals can make a significant contribution by adopting a positive attitude toward hepatitis B immunization, promoting a healthy lifestyle, as well as in pointing out bad lifestyle habits and the potential risks associated with such behavior (24-27).

## RESEARCH GOAL

The aim of the research is to collect, statistically analyze, and compare data on age, gender and the number of hepatitis B cases in HNC and SDC.

## SUBJECTS AND METHODS

In this retrospective study, data were collected on the population size in the studied areas according to official census records, the number of registered hepatitis B cases in those areas, and the demographic data of the affected individuals (age, sex), over the period from January 1, 2014, to December 31, 2024.

For the purpose of this research, data were obtained from the database of the Public Health Institute of the Federation of Bosnia and Herzegovina, specifically the Health Statistical Yearbook, as well as from the database of the Croatian Institute of Public Health, namely the Croatian Health Statistical Yearbook. A review of the publications provided data on hepatitis B surveillance in HNC and SDC. (28, 29).

In this study, the diagnosis of hepatitis B includes both acute and chronic cases of infection.

### Statistical analysis

All collected data were entered and stored in the computer program Microsoft Excel 2007 (Microsoft, USA) and were analyzed using the statistical software SPSS for Windows (version 13.0, SPSS Inc., Chicago, Illinois, USA). Descriptive statistical methods were used for data analysis. Qualitative variables were presented as absolute numbers and percentages, while quantitative variables were expressed as mean values (M) and standard deviations (SD). The t-test was used to assess the statistical significance of differences between two arithmetic means, and the $\chi^2$ test was used to examine associations between categorical variables. A p-value of $< 0.05$ was considered statistically significant (30,31).

## RESULTS

According to the 2013 population census HNC had 236,278 inhabitants, with slightly more women (52%) than men (48%). According to the 2011 census SDC had 454,798 inhabitants, while the 2021 census recorded 423,407 inhabitants. In both censuses, women were more numerous (51.5%) than men (48.5%).

In the HNC, 11 cases of hepatitis B infection were registered between 2014 and 2024, including 6 women and 5 men (M=44.27; SD=14.74; minimum age (min)=19; maximum age (max)=61), which does not represent a statistically significant difference in the incidence by sex ($\chi^2$=0.09, p>0.05). There is a statistically significant difference in age between female and male patients (t=2.11; p=0.03). Men diagnosed with hepatitis B in the HNC were, on average, younger (M=35.4; SD=16.1; min=19; max=61) compared to women (M=51.6; SD=9.1; min=35; max=60).

In SDC, 55 cases of hepatitis B infection were registered during the same period, including 16 women and 39 men (M=49.32 years; SD=13.84; min=16; max=73). In

this county, men were statistically significantly more likely to be diagnosed with hepatitis B than women ($\chi^2$=9.61, p<0.05), while there was no statistically significant difference (t=0.47; p=0.31) in the age of female (M=48; SD=15.9; min=20; max=72) and male patients (M=49.9; SD=12.9; min=16; max=73).

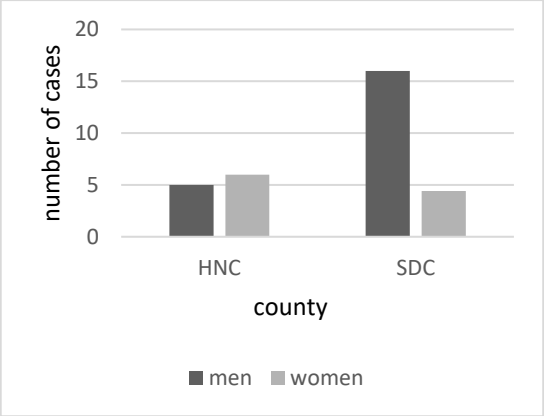


**Figure 1.** *Distribution of reported hepatitis B infections from 2014 to 2024, by sex in HNC and SDC.*

There is no statistically significant difference in the age at which hepatitis B was diagnosed in patients from both counties (t=1.09; P=0.14), but when comparing the age of patients by gender, it is found that men with hepatitis B infection in SDC are statistically significantly older than men from HNC (t=2.29; P=0.01), while there is no age difference for women (t=0.52; P=0.3).

The number of registered cases of hepatitis B infection by year from 2014 to 2024 in HNC is shown in Table 1, and in SDC in Table 2. The rates are expressed per 100,000 inhabitants.

**Table 1.** *Number of reported hepatitis B cases and rates per 100 000 population in the HNC by year, from 2014 to 2024.*

| years | 2014. | 2015. | 2016. | 2017. | 2018. | 2019. | 2020. | 2021. | 2022. | 2023. | 2024. | test* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | N° %000 | $\chi^2$ | p |
| | 1 0,42 | 0 - | 2 0,85 | 1 0,42 | 3 1,27 | 1 0,42 | 0 - | 2 0,85 | 0 - | 0 - | 1 0,42 | 10 | >0.05 |

*Fisher exact test

In the HNC, during the observed period, a total of 11 hepatitis B cases were registered, with the highest number (3 cases) reported in 2018. No cases were registered in 2015, 2020, 2022, and 2023.

The average annual notification rate was 0.42 %000, and there was no statistically significant difference in the number of reported cases across the years ($\chi^2$=10, p>0.05).

**Table 2.** *Number of reported hepatitis B cases and rates per 100 000 population in the SDC by year, from 2014 to 2024.*

| years | 2014. | 2015. | 2016. | 2017. | 2018. | 2019. | 2020. | 2021. | 2022. | 2023. | 2024. | test* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N° | N° | N° | N° | N° | N° | N° | N° | N° | N° | N° | $\chi^2$ | p |
| | %000 | %000 | %000 | %000 | %000 | %000 | %000 | %000 | %000 | %000 | %000 | | |
| | 5 | 11 2,42 | 11 2,42 | 7 | 4 | 8 | 2 | 0 | 0 | 2 | 5 | 30,8 | <0.05 |
| | 1,1 | | | 1,54 | 0,88 | 1,76 | 0,44 | - | - | 0,47 | 1,18 | | |

*Fisher exact test

In the SDC, the highest number of hepatitis B cases (11) was registered in 2015 and 2016, while no cases were reported in 2021 and 2022. The average annual notification rate of hepatitis B infection was 0.96 %000, with a statistically significant difference in the number of cases across the years ($\chi^2$=30.800, p<0.05).

Table 3 presents a comparison of the number of cases and infection rates of hepatitis B in the HNC and SDC for the observed period from 2014 to 2024. The overall notification rate of hepatitis B in SDC was 12.21%000, compared to 4.66 %000, in HNC, representing a statistically significant difference ($\chi^2$=29.333, p<0.05). The infection rate in SDC was significantly higher than in HNC in 2015 and 2016 ($\chi^2$=6.231, p<0.05), in 2017 ($\chi^2$=4.5, p<0.05), and in 2019 ($\chi^2$=5.444, p<0.05), while no statistically significant differences were observed in the remaining years.

**Table 3.** *Comparison of the number of hepatitis B cases and infection rates by year between the HNC and SDC from 2014 to 2024.*

| Year | Number of cases and infection rates per 100 000 population | | | | $\chi^2$ | p |
|---|---|---|---|---|---|---|
| | HNC | | SDC | | | |
| | Number | %**000** | Number | %**000** | | |
| 2014. | 1 | 0.42 | 5 | 1.10 | 2.667 | >0.05 |
| 2015. | 0 | - | 11 | 2,42 | 6,231 | <0.05 |
| 2016. | 2 | 0.85 | 11 | 2,42 | 6,231 | <0.05 |
| 2017. | 1 | 0.42 | 7 | 1,54 | 4,5 | <0.05 |
| 2018. | 3 | 1.27 | 4 | 0.88 | 0,143 | >0.05 |
| 2019. | 1 | 0.42 | 8 | 1.76 | 5.444 | <0.05 |
| 2020. | 0 | - | 2 | 0.44 | 2 | >0.05 |
| 2021. | 2 | 0.85 | 0 | - | 2 | >0.05 |
| 2022. | 0 | - | 0 | - | - | - |
| 2023. | 0 | - | 2 | 0.47 | 2 | >0.05 |
| 2024. | 1 | 0.42 | 5 | 1,18 | 2,667 | >0.05 |
| OVERALL | 11 | 4.66 | 55 | 12,21 | 29,333 | <0.05 |

## DISCUSSION

In the conducted research, it was determined that the average annual rate of reported infections in both counties is below 1 per 100,000 inhabitants, while the rate of reported hepatitis B infections in the HNC and SDC during the observed period was also low 4.66 per 100,000 and 12.21 per 100,000, as demonstrated in previous studies (1-3, 6-12). The overall rate of hepatitis B infection in the SDC is significantly higher than in the HNC

($p<0.05$). This difference reflects a significantly higher number of reported hepatitis B cases in four years: 2015, 2016, 2017, and 2019, while no such difference was observed in other years ($p>0.05$). During the COVID-19 pandemic (2020–2023), there was a very small number of reported hepatitis B infections in both counties. This could be justified by the fact that, during the pandemic years, there was a noticeable underreporting of other infectious diseases. A similar effect, particularly in 2020, was observed in EU countries, where there was a sharp decline in infection reports due to the disruption of services responsible for disease prevention. Furthermore, COVID-19 restrictions limited the movement of the population and reduced potential risky sexual activities. The increased reporting after 2021 can be explained by the end of pandemic restrictions, the recovery of the healthcare system, the revival of testing initiatives, changes in disease surveillance, increased migration, and a rise in infection transmission (4,5).

The significantly higher rates of hepatitis B in SDC compared to HNC are also attributed to the geographical location of SDC. Due to higher traffic of people, goods, and drugs, as well as more developed tourism, maritime traffic, and the presence of world-renowned destinations for youth entertainment, there are greater opportunities for risky behavior (unprotected sexual intercourse, drug use) (1-3, 6-12, 16-18, 20-22).

In SDC, during the observed period, significantly more men than women were reported ($p<0.05$), which could likely be explained by the fact that men tend to engage in riskier behaviors. Such gender differences were not observed in HNC, but overall, the number of registered cases is small, making it difficult to draw definitive conclusions. There is a significant difference in the age structure of reported hepatitis B infections in HNC, where women are, on average, older than men ($p<0.05$), while the results from SDC indicate no such difference ($p>0.05$). The registered age difference in hepatitis B cases in HNC can be explained by the small number of reported patients rather than any age-related risk factor.

In EU countries, between 2014 and 2019, the highest number of reported hepatitis B infections, around 30%, was in the age group of 25-34 years. From 2020 to 2022, the number of reported cases became almost equal in the age groups of 25-34 years and 35-44 years, which together account for 50% of the total number of reported cases (4,5).

In SDC, the highest number of reported hepatitis B infections is in the age group of 55-64 years (31%), followed by the age group of 45-54 years (16%). In HNC, the most common age for detection and reporting of infection is also 55-64 years (36%). This indicates that the detection of hepatitis B infections in younger age groups is very rare in both HNC and SDC, which is likely due to the mandatory hepatitis B vaccination program. A similar effect is observed in EU countries, where less than 20% of all reported hepatitis B infections are detected in individuals under 25 years of age. The shift in hepatitis B incidence to older age groups is understandable due to the introduction of the mandatory vaccination program in Croatia in 1999 for children at the age of 12, and in 2007 for infants, which has protected younger age groups at a time

when they are otherwise most exposed to infection risks (1,2,4-8).

This study identified differences in the rates of reported hepatitis B infections between the observed counties, which geographically border each other but belong to separate countries. Similarly, there are differences in infection reporting rates among EU countries. The highest rates of reported infections are found in the northern and western countries of Europe. Geographical variations are primarily a reflection of testing policies, reporting practices, and epidemiological differences. The highest rates of reported hepatitis B infections have been observed in countries of Southern and Eastern Europe. The detection of chronic hepatitis B infections is a result of the intensity of either local or national screening and testing strategies. It has been proven that the highest rates of detected hepatitis B infections are found in countries with comprehensive testing programs, such as Finland, Norway, Sweden, Latvia, Ireland, Iceland, Luxembourg, the Netherlands, Germany, Poland, and Austria (5). Therefore, the differences observed in this study may not necessarily reflect the actual prevalence of hepatitis B. The epidemiological data on hepatitis B obtained in this study are important for guiding the prevention and treatment of this disease and contribute to the progress toward the global goal of hepatitis elimination. In fact, the WHO adopted the Global Hepatitis Strategy in 2017 with the aim of eliminating the disease by 2030. To achieve this, it is necessary to reduce the incidence of chronic hepatitis by 90% and related mortality by 65% compared to 2015 levels. Comprehensive vaccination programs, testing in high-risk groups, treatment of patients, prevention of mother-to-child transmission, and programs targeting drug users are key to accelerating the elimination of hepatitis worldwide (4,5).

## CONCLUSION

It has been determined that both counties have a low incidence rate of hepatitis B. Further research is needed to be conducted in both counties, covering a larger number of participants over a longer period of time, which would make the results more relevant. All the data on hepatitis established in this study, as well as the data that will be discovered in future research, contribute to the WHO's goal of hepatitis elimination worldwide by 2030.

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# UČESTALOST OBOLIJEVANJA OD HEPATITISA B U DESETOGODIŠNJEM RAZDOBLJU U HERCEGOVAČKO-NERETVANSKOJ I SPLITSKO-DALMATINSKOJ ŽUPANIJI

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## SAŽETAK

Uvod: Virusni hepatitis B je akutna, ali i kronična bolest jetre prouzročena virusom hepatitisa B (HBV), koja je i dalje javnozdravstveni problem, unatoč učinkovitom cjepivu i antivirusnim lijekovima koji mogu zaustaviti replikaciju virusa. Cilj istraživanja je prikupiti, statistički obraditi i usporediti podatke o dobi, spolu i broju oboljelih od hepatitisa B u Hercegovačko-neretvanskoj (HNŽ) i Splitsko-dalmatinskoj županiji (SDŽ). Ispitanici i postupci: U retrospektivnoj studiji prikupljeni su podaci o broju stanovnika kao i broju registriranih bolesnika s hepatitisom B na područjima ovih dvaju županija, te demografski podatci oboljelih (dob, spol) kroz vremensko razdoblje od 01.01.2014. do 31.12.2024. godine. Rezultati: U HNŽ u ispitivanom razdoblju registrirano je 11 osoba s hepatitisom B, gotovo podjednak broj žena i muškaraca, a oboljeli muškarci su u prosjeku bili značajno mlađi od žena ($p<0.05$). U SDŽ u istom razdoblju registrirano je 55 osoba s hepatitis B infekcijom, od čega značajno više muškaraca nego žena ($p<0.05$), dok nije bilo statistički značajne razlike u dobi oboljelih ($p>0.05$),. Prosječna godišnja stopa prijavljenih infekcija hepatitisom B u promatranom razdoblju u HNŽ iznosila je 0.42 ‰, a u SDŽ 0.96 ‰. Ukupna stopa infekcije hepatitisom B u SDŽ iznosila je 12,21 ‰, i bila je značajno viša nego u HNŽ gdje je iznosila 4,66‰ ( $p<0.05$). Zaključak: Utvrđeno da područja obaju županija imaju nisku stopu obolijevanja od hepatitisa B. Epidemiološki podatci o hepatitisu B dobiveni u ovom istraživanju važni su za usmjeravanje prevencije i liječenja ove bolesti na ispitivanim područjima i doprinose jednom od ciljeva Svjetske zdravstvene organizacije (SZO), a to je eliminacija hepatitisa u svijetu do 2030. godine.

**Ključne riječi**: hepatitis B, incidencija, eliminacija, Splitsko-dalmatinska županija, Hercegovačko-neretvanska županija.

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# INFLUENZA VACCINATION IN THE HEALTH CENTER OF THE SPLIT-DALMATIA COUNTY IN VRGORAC

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## ABSTRACT

Introduction: Adults over 65 years of age have the highest mortality rate from lower respiratory tract infections caused by influenza. People who live with or care for patients in risk groups, such as healthcare workers, should be vaccinated. Low influenza vaccination rates among certain at-risk groups contribute to the burden of disease and remain a major public health challenge. The coronavirus disease 2019 (COVID-19) pandemic has had a significant impact on seasonal influenza.

Aim: Investigate the coverage of influenza vaccination among adults at the Health Center of the Split-Dalmatia County in Vrgorac.

Materials and methods: A retrospective analysis was conducted. Data on influenza vaccinations from January 01, 2019 to December 31, 2024 at the Health Center of the Split-Dalmatia County in Vrgorac were analyzed from the electronic immunization database. The following variables were included in the analysis: vaccination coverage by year, subject category (older than 65, chronically ill, healthcare worker, other), and subject gender.

Results: A total of 2090 doses of influenza vaccine for adults were consumed. The most vaccine doses were consumed in 2020, 512 doses, and the fewest vaccine doses were consumed in the last two years, 257 and 296, respectively ($p<0.05$). The largest number of patients was over 65 years old, 1214, 833 were chronic patients, while 26 were healthcare workers ($p<0.05$).

Conclusion: A statistically significantly lower consumption of vaccine doses was found during and after the end of the COVID-19 pandemic compared to the time before the pandemic. Healthcare workers were statistically significantly less vaccinated against influenza compared to other groups.

**Keywords:** Influenza, human flu, vaccination, immunization, vaccines

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## INTRODUCTION

Seasonal influenza, commonly known as the flu, is an acute and infectious respiratory virus. Millions of people are infected with the flu virus every year, mostly in temperate regions, and sporadic spikes in prevalence in tropical areas. It causes diseases that vary in severity of symptoms and sometimes lead to hospitalization and death. Most people recover from fever and other symptoms within a week without needing medical attention. However, influenza can cause serious illness or death, especially among high-risk groups including the very young, the elderly, pregnant women, healthcare workers and people with serious health problems (1). There are more than 1 billion flu cases each year, of which 3-5 million are severe cases and 290,000-650,000 respiratory deaths related to influenza worldwide (2, 3). Older adults are at higher risk of developing severe influenza, influenza complications, hospitalization, and death than other populations. Adults over 65 years of age have the highest mortality rate from lower respiratory tract infections caused by influenza (4). Vaccination with the trivalent inactivated vaccine is the most effective method of preventing influenza and should be offered to patients in risk groups. People who live with or care for patients in risk groups, such as healthcare workers, should be vaccinated (5). Influenza vaccination rates are low among underserved populations, whose primary healthcare access is through emergency departments (6). Declining vaccination rates among adults against influenza are also being recorded in developed countries around the world, such as the United States, despite the fact that vaccines are key in reducing vaccine-preventable diseases (7). Low influenza vaccination rates among certain at-risk groups contribute to the burden of disease and remain a major public health challenge (8).

The coronavirus disease 2019 (COVID-19) pandemic has had a significant impact on seasonal influenza by changing the seasonality of the virus and reducing detection rates (9). In relation to chronic diseases, populations aged 50-64 are recommended for vaccination or are classified as a risk group in the case of chronic diseases. Some authors point out the low vaccination coverage of people over 60 years of age, although this is the age group that falls into the risk group for chronic diseases. In order to improve influenza vaccination rates in all age groups, it is necessary to conduct research and devise strategies to increase vaccination coverage rates (10).

The aim of this study was to investigate the coverage of influenza vaccination among adults at the Health Center of the Split-Dalmatia County in Vrgorac. Additional objectives were to investigate the trend of influenza vaccination after the start of the COVID-19 pandemic in the Republic of Croatia.

## MATERIALS AND METHODS

A retrospective analysis was conducted between January and April 2025. Vaccination data were collected from the electronic immunization database of the local Health Center, which routinely collects data on all administered vaccines. Data on influenza vaccinations from January 01, 2019 to December 31, 2024 at the Health Center of the Split-Dalmatia County in Vrgorac were analyzed.

The inclusion criteria for the study were adults who were vaccinated at the Split-Dalmatia County Health Center Vrgorac and who were recommended to undergo influenza vaccination, persons over 65 years of age, residents and employees of nursing homes and long-term care institutions, employees of nursing homes, elderly people with chronic diseases (diseases of the heart and circulatory system, lungs, kidneys, metabolism, nervous and immune systems), and healthcare workers. Children and adolescents aged 6 months to 18 years, pregnant women and persons under 65 years of age who are not chronically ill were excluded from the study. All patients were vaccinated with a dose of the Vaxigrip Tetra vaccine. The Croatian Institute of Public Health ensures a sufficient number of doses of the Vaxigrip Tetra influenza vaccine for each influenza season. Influenza vaccination is carried out in primary health care offices and in public health institutes. For certain risk groups, the vaccine is recommended and free of charge: including people in close contact with the aforementioned groups (in case the person in the risk group has a contraindication) (11).

Adults receive a single dose of 0.5 ml. The recommended dose of the vaccine is administered as an injection into a muscle or subcutaneously. The vaccine was stored according to the manufacturer's instructions, refrigerated (2°C – 8°C), not frozen. The syringe was kept in the outer carton to protect from light (12). All vaccinated people are informed about the possible side effects of the vaccine. Common side effects include: headache, muscle pain (myalgia), general feeling of weakness, pain at the application site, fever, chills, application site reactions: erythema, swelling, induration.

The following variables were included in the analysis: vaccination coverage by year, subject category (older than 65 (>65), chronically ill, healthcare worker, other), and subject gender. The “Other” category includes people who pay for the vaccine themselves and who brought the flu vaccine with them for vaccination.

### Statistical analysis

The statistical software SPSS (Statistical Package for Social Sciences) for Windows, version 26.0 (IBM, Armonk, New York, USA) was used for data analysis. This program is user-oriented. The collected data were processed using the method of descriptive statistics. The results are presented descriptively, in tables and graphs, in absolute numbers and percentages. The chi-square test ($\chi 2$) was used to determine the significant relationship between two nominal (categorical) variables. The probability level of $p<0.05$ was taken as statistically significant. The dispersion of the data is defined by the 95% confidence interval, 95% CI (Confidence Interval).

### Ethical principles

Because this study was a public health surveillance, ethics committee or institutional review board approval was not required. When collecting and analyzing data, we took care of their anonymity. All data is encrypted and stored in a safe place.

## RESULTS

In the observed period, according to available data, a total of 2090 doses of influenza vaccine for adults were consumed. Of the total number of

vaccinated adults, 1055 were men and 1035 were women. The difference in respondents by gender was not statistically significant ($\chi2=0.191$, df=1, p=0.662).

The most vaccine doses were consumed in 2020, 512 doses, and the fewest vaccine doses were consumed in the last two years, 257 and 296, respectively ($p<0.05$). The difference in the number of adults vaccinated against influenza by year was statistically significant ($p<0.05$) (Figure 1).

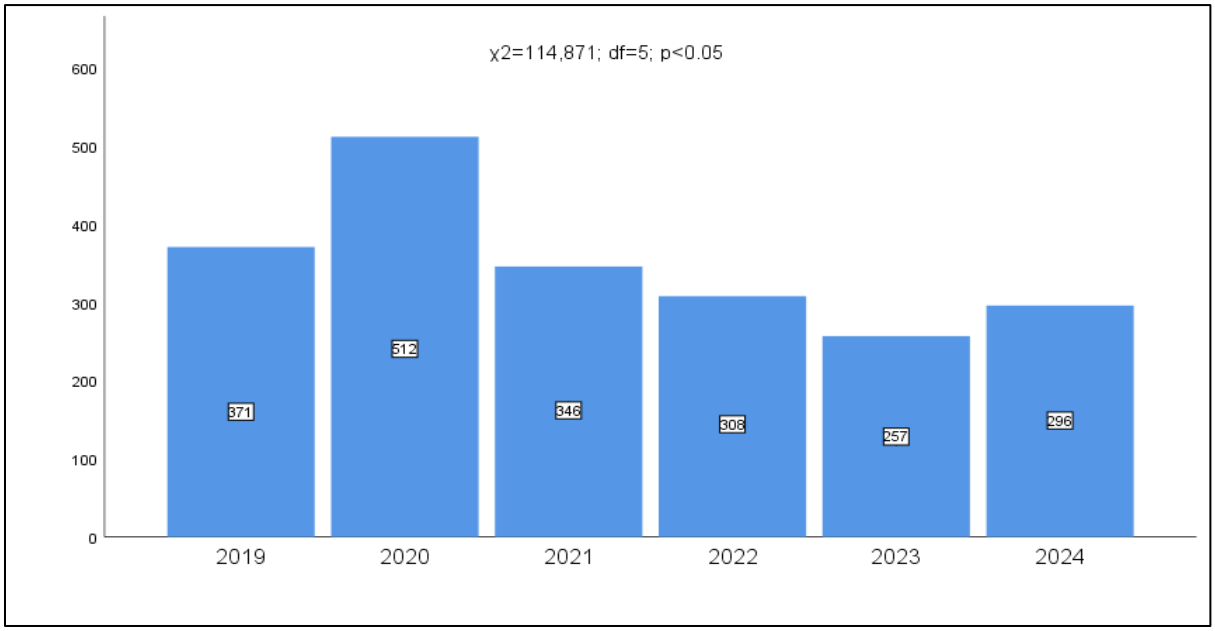


**Figure 1.** *Number of vaccinated adults at the Health Center of the Split-Dalmatia County, Vrgorac Branch from January 01, 2019 to December 31, 2024.*

The largest number of vaccinated adults belonged to the category "over 65 years of age", 1214 of them. Of the total number of vaccinated, 833 were chronic patients, while 26 were healthcare workers. The difference in the number of vaccinated people compared to the category of respondents was statistically significant ($p<0.05$) (Figure 2).

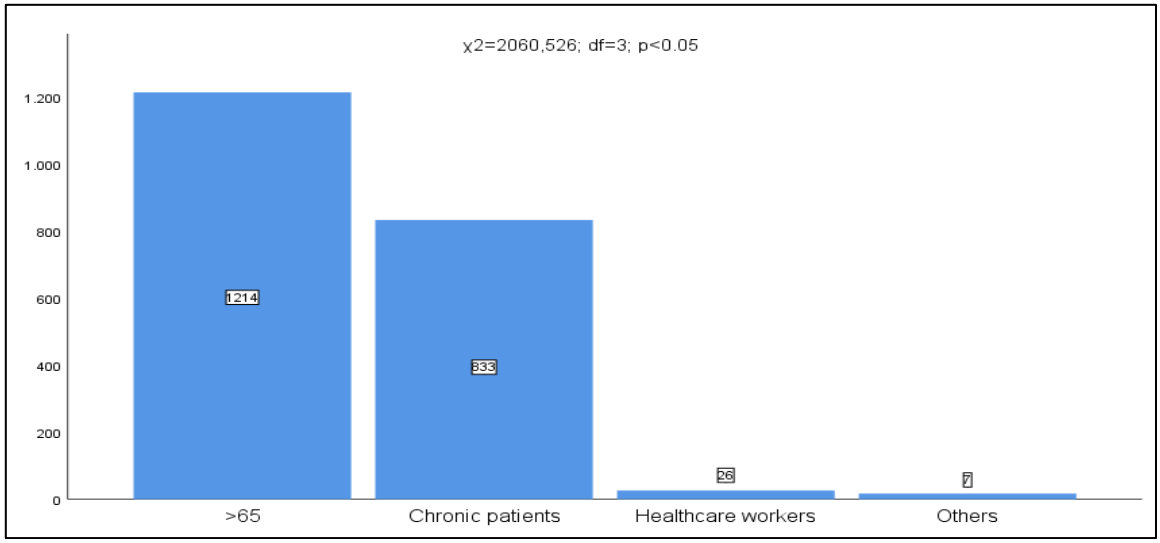


**Figure 2.** *Number of vaccinated adults by category*

The largest number of respondents belonging to the categories "Over 65" and "Chronic patients" were vaccinated in 2020, 289 and 210 respectively. The largest number of healthcare workers were vaccinated in 2021, 10. The difference in the number of respondents by group in relation to the year of vaccination was statistically significant (p<0.05) (Table 1).

**Table 1.** *Difference in the number of vaccinated people by year and category*

| | | Category | | | | | |
|---|---|---|---|---|---|---|---|
| | | >65 | Chronic patients | Healthcare workers | Others[a/b] | Total | P |
| Year | 2019 | 205 | 154 | 8 | 4 | 371 | p <0.05 |
| | 2020 | 289 | 210 | 4 | 9 | 512 | |
| | 2021 | 232 | 104 | 10 | 0 | 346 | |
| | 2022 | 200 | 107 | 0 | 1 | 308 | |
| | 2023 | 124 | 132 | 1 | 0 | 257 | |
| | 2024 | 164 | 126 | 3 | 3 | 296 | |
| Total | | 1214 | 833 | 26 | 17 | 2090 | |

[a]The patient pays for the vaccine themselves; [b]The patient brought the vaccine with him/her

Figure 3 shows that the flu vaccination trend is lower during and after the COVID-19 pandemic.

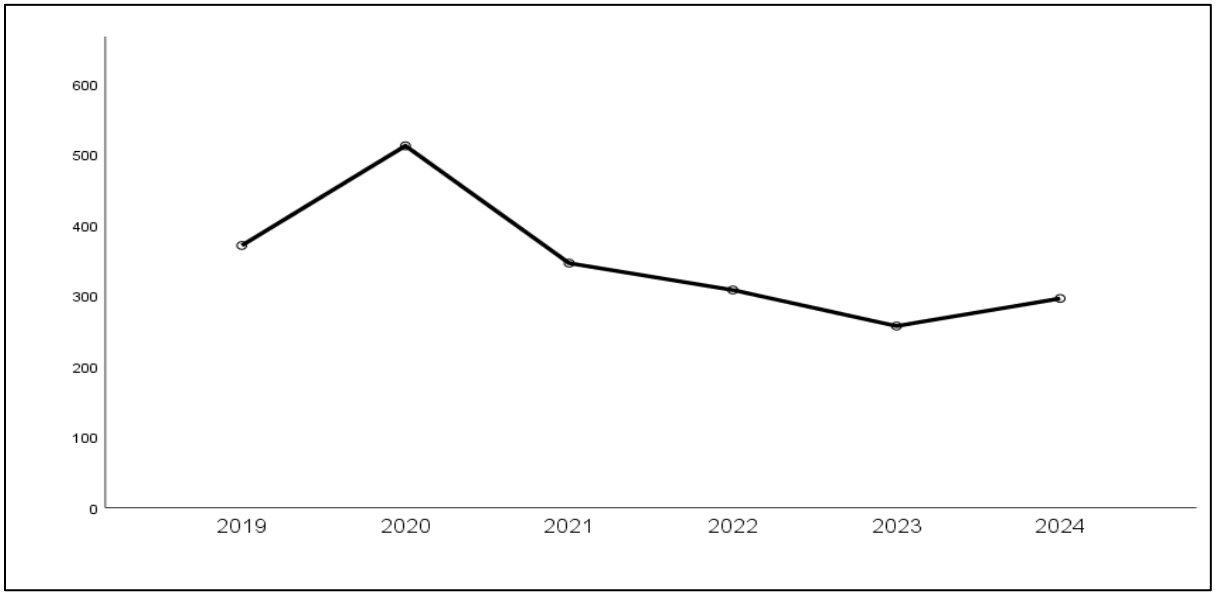


**Figure 3.** *Vaccination trend at the Health Center of the Spit-Dalmatia County, Vrgorac Branch from January 01, 2019 to December 31, 2024.*

## DISCUSSION

In relation to the main aim of our study, our results showed that in 2020, the vaccination rate was 8.98%, compared to the total population. According to the 2021 census, the town of Vrgorac and its surroundings had 5,698 residents, of which 2,132 in the city of Vrgorac (13). In the period from 2020 to 2025, the vaccination rate of adults against influenza in Vrgorac decreased significantly, with the lowest vaccination rate recorded in 2023, at 4.51%. This result may be a consequence of the COVID-19 pandemic, which officially appeared in the Republic of Croatia on February 25, 2020. (14). In accordance with our results, many studies indicate a reduced vaccination coverage of

the population in the time period from the onset of the COVID-19 pandemic to today. Sun et al. report that the overall influenza vaccination coverage rate in Shanghai since the onset of the COVID-19 pandemic, especially among the elderly, is lower compared to before the pandemic (15). In a study using influenza vaccination rate data submitted by the US using the electronic Joint Immunization Reporting Form (eJRF) for the time period 2019-2021, a 21.0% decrease in influenza vaccination rate among adults was observed (16). Macdonald points out that factors such as complacency, trust, and comfort play an important role in preventing adults from hesitating to get the flu vaccine, and that experts and health care professionals should work to study these variables as hindering factors in getting the flu vaccine (17). Adults who refuse vaccination due to complacency view influenza as a non-serious illness, believe they are at minimal risk, and view the influenza vaccine as less important. A meta-analysis by Brewer et al. identified perceived low personal risk of disease as a significant factor contributing to adults' hesitation to get vaccinated against influenza (18). Other factors that may lead to differences in influenza vaccination rates following the COVID-19 pandemic include the presence of different COVID-19 variants and the availability of mRNA vaccines. González-Block et al. state that strategies tailored to the specific context and needs of target groups need to be developed to increase trust and reduce disinterest in influenza vaccines (19). Puri and Coomes emphasize in their study that health campaigns and healthcare professionals must remain relentless in highlighting the fact that influenza vaccination is an immunization tool that significantly contributes to protecting individuals and communities. At the same time, these same experts should strongly oppose social media narratives that promote anti-vaccination activities (20). Some authors point to the importance of targeted communications to address false myths surrounding specific vaccinations as more successful methods than broad vaccination promotion initiatives, which require strategic methods that emphasize sustainable regular and seasonal vaccination initiatives while increasing availability (21). The rise in vaccine misinformation and hesitation during the COVID-19 pandemic may have led to a decline in vaccination rates and needs to be further investigated and addressed to reverse the decline in vaccination rates (22, 23). The COVID-19 pandemic is impacting health behaviors and vaccination patterns. Findings from some studies highlight the transient impact of the pandemic on influenza vaccine uptake in Canada. The increasing use of pharmacies as vaccination sites highlights the importance of accessible and convenient vaccination sites in increasing adult vaccination coverage (24). Recent research indicates that vaccination is often age-related, so there is a need for tailored information about the effects of influenza on cardiovascular disease for adults, especially peripheral arterial disease (25).

Our results showed a low vaccination rate among healthcare workers. Concerns about the hesitancy to vaccinate healthcare workers have become particularly prevalent during and after the COVID-19 pandemic (26). Prior studies suggest that healthcare workers are at significant risk of exposure to the influenza virus during their

daily patient care duties, which places them in a group that is particularly susceptible to influenza infections (27). Some authors bring some information about another important finding that points to the importance of flu vaccination for healthcare workers. Healthcare workers can transmit the flu to susceptible patients, which instantly increases the risk of getting the flu for the patients themselves (28). The World Health Organization recommends that influenza vaccination of healthcare workers should be carried out once a year (1). A study by Alkathlan et al. shows that the Saudi Ministry of Health has advised that all healthcare workers receive mandatory annual influenza vaccination. In addition, influenza vaccine is provided free of charge in hospital settings for all healthcare workers (29). Such an initiative allows for increased vaccination rates among healthcare workers and creates a positive environment that prevents the spread of infectious diseases among healthcare workers and their patients. However, consistent with our study, several studies have reported reduced influenza vaccination rates among healthcare workers despite vaccination promotion campaigns and conditions for influenza vaccination (30, 31). An important factor in influenza vaccination refusal is the education of health professionals or the promotion of such vaccines by professional initiatives (32). Adults refuse to get vaccinated against influenza for various reasons: their good health, then concerns about side effects, they are well enough not to be infected with influenza, and ignorance about the availability of influenza vaccines (33). Previous studies have shown that selected factors such as high education and living in a city are associated with a positive attitude towards vaccination and greater concern about its side effects (34). Some authors have also suggested that the most common source of information about vaccination is cited as healthcare professionals, but also the internet and friends. Healthcare workers should be a source of reliable information about the benefits and possible side effects of vaccination (35). Our study used the VaxiGrip vaccine. When a person receives Vaxigrip Tetra, the immune system (the body's natural defence system) will produce its own protection against the disease (antibodies). Some authors confirms that a quadrivalent inactivated split-virion influenza vaccine Vaxigrip Tetra is well tolerated and has an acceptable safety profile in routine practice in South Korea. Authors stated that no unexpected safety concerns were identified (12).

There are several limitations of this study. The limitations of the present studies naturally include the availability of only those data that were entered into the institution's electronic database. There is a possibility that some data on the category of respondents were entered incorrectly. A study of this design does not make it possible to determine the reasons and attitudes of the respondents in relation to the refusal of vaccination. We recommend that in future research, the authors additionally apply the focus group method, which will obtain more subjective explanations of the respondents' attitudes about the reasons for refusing vaccination. In this study, due to the availability of data, only data from the Vrgorac Branch were analyzed. In future research, the research population should be expanded to other health centers in the Split-Dalmatia County

in order to increase the reliability of drawing conclusions about the trend of influenza vaccination. Although our results clearly showed that the rate of influenza vaccination has been declining since the beginning of the COVID-19 pandemic, additional research is needed to further determine the vaccination trend and investigate the connection between the rate of influenza vaccination and the occurrence of the COVID-19 pandemic.

## CONCLUSIONS

In the observed period, a statistically significant difference was recorded in the number of adults vaccinated against influenza. A statistically significantly lower consumption of vaccine doses was found during and after the end of the COVID-19 pandemic compared to the time before the pandemic. The largest number of respondents were statistically significantly older than 65 years of age. Healthcare workers were statistically significantly less vaccinated against influenza compared to other groups. It is necessary to implement appropriate strategies and programs aimed at different populations in order to increase the coverage of influenza vaccination of adults, which is declining, especially healthcare workers.

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# CIJEPLJENJE PROTIV GRIPE U DOMU ZDRAVLJA SPLITSKO-DALMATINSKE ŽUPANIJE, ISPOSTAVA VRGORAC

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## SAŽETAK

Uvod: Osobe starije od 65 godina imaju najveću stopu smrtnosti od infekcija donjih dišnih putova uzrokovanih gripom. Osobe koje žive s pacijentima iz rizičnih skupina ili se o njima brinu, poput zdravstvenih djelatnika, trebaju se cijepiti. Niske stope cijepljenja protiv gripe među određenim rizičnim skupinama pridonose teretu bolesti i ostaju veliki javnozdravstveni izazov. Pandemija koronavirusne bolesti 2019 (COVID-19) značajno je utjecala na sezonsku gripu.

Cilj: Istražiti cjepni obuhvat protiv gripe odraslih osoba u Domu zdravlja Splitsko-dalmatinske županije, Ispostava Vrgorac.

Materijali i metode: Provedena je retrospektivna analiza. Podaci o cijepljenju prikupljeni su iz elektronske baze podataka o cijepljenju. Analizirani su podaci o procijepljenosti odraslih osoba protiv gripe od 01. siječnja 2019. do 31. prosinca 2024. godine u Domu zdravlja Splitsko-dalmatinske županije, Ispostava Vrgorac. U analizu su uključene sljedeće varijable: cjepni obuhvat po godinama, kategorija ispitanika (stariji od 65, kronični bolesnik, zdravstveni djelatnik, ostalo) i spol ispitanika.

Rezultati: Potrošeno je ukupno 2090 doza cjepiva protiv gripe za odrasle osobe. Najviše doza cjepiva potrošeno je 2020. godine, 512 doza, a najmanje doza cjepiva potrošeno je u zadnje dvije godine, 257 odnosno 296 ($p<0,05$). Najveći broj oboljelih bio je stariji od 65 godina, njih 1214, 833 su kronični bolesnici, dok je 26 zdravstvenih djelatnika ($p<0,05$).

Zaključak: Utvrđena je statistički značajno manja potrošnja doza cjepiva tijekom i nakon završetka pandemije COVID-19 u odnosu na vrijeme prije pandemije. Zdravstveni djelatnici su statistički značajno manje cijepljeni protiv gripe u odnosu na ostale skupine.

**Ključne riječi:** Gripa, influenca, cijepljenje, imunizacija, cjepivo

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# COMPARISON OF PARENTAL ATTITUDES ON CHILD VACCINATION WITH REGARD TO MEDICAL EDUCATION

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## ABSTRACT

Objective: Examine the attitudes of parents towards vaccination of children as well as the reasons for any negative attitude. In doing so, to determine whether there are differences in attitudes depending on formal medical education.

Subjects and Methods: Data were collected from 100 participants at the Srebrnjak Children's Hospital via an anonymous questionnaire. The questionnaire consists of 14 questions that include some relevant parameters such as the age of the parents, number of children, education, previous experience with vaccines, etc. The data were processed using the $\chi 2$ test, with a significance level of $p<0.01$.

Results: Data processing determined that in the sample examined, which was divided into those with and those without medical education, there was a significant difference in terms of information about vaccination and the source of this information. The results show that parents with medical education are significantly better informed than parents without medical education. Regarding the influence of the media, a significant difference was found, with those with medical education being less susceptible to media influence regarding child vaccination. There was no significant difference according to the level of education, place of residence, number of children in the family, frequency of vaccination and occurrence of vaccination complications, reasons for negative attitude, or experience of other parents.

Conclusion: Medically educated parents have greater knowledge about vaccines and possible complications of vaccination, consult professionals more often, and are less susceptible to media influence, but regardless, they are equally skeptical about the benefits of vaccinating their children.

**Keywords**: vaccination, children, parental education, parental attitudes

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## INTRODUCTION

Vaccination is a procedure that achieves specific immunity to one or more antigens, and is carried out to prevent disease. It is one of the most successful preventive medical interventions (1) and the greatest achievements in medicine and public health, and the best way to prevent the spread of infection, as well as the development of disease and its complications (2).

Vaccination achieves benefits for the individual who is vaccinated and for the entire social community. Protection against the disease against which the vaccine is given is achieved within a certain time and proportion of the population covered (3-6). Individual countries differ in terms of national vaccination schedules and the diseases included, the types and combinations of vaccines, the timing of vaccination and the age at which a particular vaccine is administered (7). The high proportion of the population vaccinated in childhood indicates that vaccination is a widely accepted measure (8), and maintaining these rates at a high level is important for reducing the incidence of infectious diseases and the occurrence of their complications (9).

Although vaccination has proven to be one of the most successful preventive measures, in recent years there has been a lot of media discussion about its inadvisability and side effects. The refusal of parents to vaccinate their children has led to a decrease in the frequency of vaccination, which ultimately results in an increase in the incidence of diseases that were in the elimination phase.

With the development of social networks, controversies have begun to arise regarding the justification of vaccination and the questioning of how useful/safe a particular vaccine actually is. Fear of the possible consequences of vaccination has emerged among parents. Such fear stems from anti-vaccination movements that spread their beliefs and claims via social networks with the participation of well-known public figures (10). The fundamental fear of parents relates to the question of how vaccination will affect the health of the child (11-13).

Vaccinations and vaccines have been the subject of public debate in recent years. Refusal and delay by parents to vaccinate their child is a public health risk (14). Health professionals should use their authority, knowledge and information from evidence-based medicine to inform and educate parents and promote vaccination and minimize its refusal (15).

Parents' perception of vaccination is directed towards the well-being of the child. For them, the safety of vaccines and the fear of unwanted side effects are the most important. In addition, measles, rubella, and mumps are considered by parents to be mild diseases that are easily treated with care and medical attention (16).

In recent years, great importance has been attached to the development of the child's natural immune system, healthy nutrition, and the positive effects of breastfeeding, which, with good hygiene conditions, are often considered sufficient protection against infectious diseases even without vaccination (17). The number of vaccines administered is problematic for parents, as are combination vaccines due to the various antigens that are simultaneously introduced into the child's body. Computerization brings the possibility of incorrect assessment and interpretation of expert papers, access to inaccurate information, which confuses parents (18,19).

A growing number of parents refuse to vaccinate their children for fear of side effects and are not familiar with the risk of such behavior, although, according to data from various studies, the actual frequency of allergic reactions to vaccinations is minor (0.65 to 1.53 cases per million doses of vaccine) (20).

Parents can also obtain information about vaccination from non-healthcare workers, from family, friends, other parents, the media, and their children's educators. Non-healthcare professionals working with children (e.g., preschool teachers, educators, psychologists, speech therapists, etc.), although they do not understand the pathogenesis and consequences of vaccine-preventable diseases, nor the complexity of indications and contraindications for vaccination, often contribute to parents' indecision with their comments. The increasing trend of refusal of children to be vaccinated for non-medical reasons is worrying, and in some communities it ranges from 1% to as much as 26% (21).

Communication between the primary care physician and parents is of utmost importance in educating parents about vaccination. Today's parents want to be partners in decision-making. Such direct communication is more important than messages in brochures and population campaigns, but it requires additional effort and time (22).

## OBJECTIVE

The objective of the study is to compare parents' attitudes towards vaccination of their children with regard to some sociodemographic parameters and medical education.

## SUBJECTS AND METHODS

In order to compare parents' attitudes and whether the level and type of education (medical/non-medical) have a significant impact on their attitudes towards vaccination of their children, an anonymous survey of 100 parents was conducted using a self-administered questionnaire. Approval for the research was granted by the Ethics Committee of the Children's Hospital Srebrnjak. The anonymous survey was conducted among parents when they came to the hospital with their children for a medical examination (Appendix). Participants previously gave written consent, after the purpose of the survey was explained to them.

The questionnaire consists of 14 questions covering some relevant parameters such as age, formal medical education, number of children, previous experience with vaccination, etc. The obtained data were analyzed to determine the significance of the differences in attitudes. The $\chi 2$ test was used in the statistical analysis of the data, and the significance of the difference was determined at the $p < 0.01$ level.

## RESULTS

The largest proportion of participants is between 30 and 39 years of age, while the average age is 38.8 years. Table 1 shows the difference between the genders of parents in relation to formal medical education.

**Table 1.** *Participants by gender and medical education*

| Sex | Medical | Non-medical |
|---|---|---|
| **Male** | 3 (7,9%) | 23 (37,1%) |
| **Female** | 35 (92,1%) | 39 (62,9%) |
| **SUMMA** | 38 | 62 |

$\chi^2$=10,44; **p=0,00123**

There is a significant difference between the genders of the surveyed parents, in favor of the fact that female respondents have a significantly higher level of formal medical education. The largest share of participants by level of education is made up of those with secondary education, and they are also the most common in the category of participants with formal medical education (52.6%). There is no significant difference in the level of education between the participants with regard to medical education ($\chi^2$=9,01; p=0,02917).

No significant difference was found between the studied groups in relation to the number of inhabitants in the places they come from (χ2=7.896, p=0.162).

The difference between the participants in relation to the number of children also is not significant (χ2=0.87; p=0.64597). The largest number of parents has two children, and the smallest number is those with three or more children.

The differences in relation to the regularity of vaccination is not significant (χ2=1.359; p=0.24371).

Attitudes towards the benefits of vaccination are presented in Table 2. A large proportion of surveyed parents believe that the vaccine provides a certain level of protection, and the difference is not significant (χ2=2.958; p=0.22786). Surprisingly, as many as 10.6% of participants with medical education believe that the vaccine does more harm than good.

**Table 2.** *Participants' attitudes towards vaccination in relation to education*

| Attitude to vaccination | Meadical | Non-medical |
|---|---|---|
| **The vaccine provides some protection** | 33 (86,8%) | 45 (72,6%) |
| **The vaccine does more harm than good** | 4 (10,6%) | 15 (24,2%) |
| **I don know** | 1 (2,6%) | 2 (3,2%) |

$\chi^2$=2,958; p=0,22786

Among the reasons for their negative attitude towards vaccination, parents cite possible complications after vaccination, and a few believe that vaccination does more harm than good, and the difference was not determined in relation to their formal medical education (χ2=1.079; p=0.58303).

Regarding their experience with complications after vaccination, most parents (77 of them) cite certain complications. Some of the complications listed are edema of the legs and arms, redness, rash and itching, fever, nausea, vomiting, diarrhea, and granulation inflammation with necrosis. No significant difference was found in this variable with respect to the medical education of the participants (χ2=0.726, p=0.39418).

Vaccine awareness showed significant differences ($\chi2$=20.669, p=0.00003) in favor of parents with medical education (Table 3), although the majority of participants assessed their vaccine awareness as satisfactory.

**Table 3.** *Vaccine awareness in relation to education*

| Vaccine awareness | Medical | Non-medical |
|---|---|---|
| **Good** | 13 (34,2%) | 5 (8,1%) |
| **Satisfying** | 25 (65,8%) | 38 (61,3%) |
| **Bad** | 0 (0%) | 19 (30,6%) |

$\chi^2$=20,669; **p=0,00003**

Except for those with formal medical education, parents most often gather information from other parents. No parent reported getting information about vaccination from a community nurse or family doctor (Table 4). There is a significant difference in this variable with respect to parental education, with those with formal medical education most often seeking information from a pediatrician, followed by the media ($\chi2$=15.6; p=0.00136).

**Table 4.** *Source of information about vaccination in relation to education*

| Source of information | Medical | Non-medical |
|---|---|---|
| **Pediatrician** | 24 (63,2%) | 25 (40,3%) |
| **Health visitor** | 0 (0%) | 0 (0%) |
| **Doctor of primary care** | 0 (0%) | 0 (0%) |
| **Frend** | 0 (0%) | 2 (3,2%) |
| **Other parents** | 3 (7,9%) | 26 (41,9%) |
| **Media** | 11 (28,9%) | 9 (14,6%) |
| **Other** | 0 (0%) | 0 (0%) |

$\chi^2$=15,6; **p=0,00136**

Table 5 shows the influence of the media on parents' attitudes towards vaccination. The largest number of parents responded that the media “perhaps” influenced their attitude (N=47). An equal number of parents responded that the media had (N=22) or had no influence (N=21). The influence of the media shows a significant difference between participants with regard to medical education ($\chi2$=25.031, p=0.000003). Parents with medical education are significantly less susceptible to media influence regarding the vaccination of their children.

**Table 5.** *Influence of the media on attitudes towards the vaccination of their children*

| Influence of the media | Medical | Non - medical |
|---|---|---|
| **YES** | 9 (23,7%) | 13 (20,1%) |
| **NO** | 22 (57,9%) | 9 (14,5%) |
| **Perhaps** | 7 (18,4%) | 40 (64,4%) |

$\chi^2$=25,031; **p=0,000003**

Regarding the influence of other parents' experiences, there is no significant difference among the participants ($\chi2$=0.669, p=0.41340).

## DISCUSSION

In the last few years, there has been a public debate about the possible consequences of vaccination. Parents' refusal and delay in vaccinating their children is becoming a serious public health problem (14). Parents' perception of vaccination is focused on the well-being of the child. For them, the most important things are the safety of vaccines and the fear of unwanted side effects. There is probably no topic in the media today that is more controversial than the vaccination of children. Since the very beginning of vaccination, public opinions have been divided. Therefore, this study presents parents' attitudes towards vaccination, collected using a questionnaire with different variables, depending on their formal medical education.

Research on parental attitudes towards vaccination shows that individual decision-making is complex and may involve political, cognitive, cultural, social, educational and emotional factors (23,24). In Croatia, the problem of the Roma national minority not responding to mandatory vaccination has been identified (25), and an information campaign on vaccination of this minority group was carried out within the framework of the Decade for Roma project (2).

It can be assumed that people with medical education have a professionally based attitude towards this problem. Therefore, the participants were divided into two groups, depending on their formal medical education. There is a significant difference between the genders of parents in favor of women with formal medical education. The results show that there is no significant difference between these two groups according to the level of education, place of residence and number of children. Furthermore, there is no significant difference according to the regularity of vaccination of children. Although the difference was not established, it is still significant that the share of parents who do not regularly vaccinate their children with medical education is lower compared to the share of other respondents (12.2% : 22.6%). Parents' attitudes towards vaccination and the reasons for the negative attitude also do not show a significant difference, regardless of medical education. However, it should be noted that parents with medical education are somewhat more likely to believe that vaccination provides some protection (86.8% : 72.6%). The attitude towards the frequency of complications after vaccination and the influence of other parents' experiences do not show a significant difference. It is understandable that a slightly higher percentage of medically educated parents know that complications after vaccination are possible (81.6%: 74.2%).

Regarding the level of information about vaccines, there is a significant difference between parents with regard to medical education. Namely, parents with medical education are significantly better informed about vaccines, which is self-explanatory. There is also a significant difference in the answers to the question related to the source of information about vaccination. Parents with medical education are significantly more likely to rely on the opinion of a pediatrician (63.2% : 40.3%), while those without medical education often rely on the opinion of other parents (41.9% : 7.9%). The influence of the media

on attitudes about vaccination also shows a significant difference. Parents without medical education are more likely to be influenced by the media, and the share of those on whom the media has no influence confirms this (57.9%:14.5%). Finally, there is no significant difference in terms of the influence of other parents' experiences on attitudes towards vaccination, but this influence is very high for respondents in both groups (63.2% and 54.8%).

Regarding research from other countries on parents' attitudes towards vaccination of children, one of them states that parents who received information from a doctor had a positive attitude towards vaccination (26). Parents with a negative attitude towards vaccination are those who have encountered bad experiences of other parents whose children had complications after vaccination (26). Another study, which included 414 participants, states that parents with no more than a secondary education have a positive attitude towards vaccination (27). This differs from the results presented in this study, where the level of education did not influence the parents' attitude. The same study states that parents with a positive previous experience, those who consider childhood infectious diseases to be dangerous and those who received information about vaccination from a doctor have a positive attitude towards immunization. According to the aforementioned study, immunization is more common in children whose parents have more knowledge about vaccination, those who believe that vaccination is beneficial and those who have not developed childhood infectious diseases (27).

A study in Australia found that most parents form their opinions based on political leaders and the media (28). On the other hand, a Danish study on parents' attitudes towards vaccination found no link with the influence of the media, specifically in this case for the MO-PA-RU vaccine (29).

Recently, data on this issue were published for Bosnia and Herzegovina, with interesting conclusions. Citizens of Bosnia and Herzegovina are not sure about vaccination, but they consider communication with a doctor to be important. They do not agree that vaccination causes more harm, but they believe that a vaccinated child can still get the disease against which he or she was vaccinated (2).

Parents are confused and concerned about the various contradictory information they encounter on social networks and in the media. Therefore, it is very important to work on educating the public about the importance of vaccination as one of the most effective public health preventive methods. Health professionals must direct education and advice towards promoting vaccination of children.

The limitation of this study is the fact that there is no adequately validated questionnaire and the relatively small number of respondents. Therefore, the results cannot be generalized.

## CONCLUSION

The results suggest that medically educated parents have greater knowledge about vaccines and possible complications of vaccination, consult professionals more often, and are less susceptible to media influence, but are nevertheless equally skeptical about the benefits of vaccinating their children. It is clearly necessary to better address the topic of vaccination during medical education in order to

reduce the skepticism of healthcare professionals towards vaccination as undoubtedly the most important specific public health method.

Parents who do not have medical training should be advised to seek advice on vaccination from pediatricians and other health professionals, and vaccination of children should be promoted through the media. Public health services must use arguments to refute malicious and unfounded rumors about the harmfulness of vaccination.

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# USPOREDBA STAVOVA RODITELJA O CIJEPLJENJU DJECE S OBZIROM NA MEDICINSKO OBRAZOVANJE

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## SAŽETAK

Cilj: Ispitati stavove roditelja o cijepljenju djece kao i razloge eventualnog negativnog stava. Pritom utvrditi ima li razlike u stavovima ovisno o formalnoj medicinskoj edukaciji.

Ispitanici i Metode: Podaci su prikupljeni od 100 ispitanika u Dječjoj bolnici Srebrnjak putem anonimnog anketnog upitnika. Upitnik se sastoji od 14 pitanja koja obuhvaćaju neke relevantne parametre kao što su starost roditelja, broj djece, obrazovanje, dosadašnja iskustva primjenom cjepiva i sl. Podaci su obrađeni pomoću $\chi^2$ testa, uz razinu značajnosti $p<0,01$.

Rezultati: Obradom podataka utvrđeno je kako u ispitanom uzorku, koji je podijeljen na one koji imaju i one koji nemaju medicinsku naobrazbu, postoji značajna razlika prema informiranosti o cijepljenju te prema izvoru tih informacija. Rezultati pokazuju kako su roditelji s medicinskim obrazovanjem znatno bolje informirani od roditelja koji nemaju medicinsko obrazovanje. Što se tiče utjecaja medija utvrđena je značajna razlika, pri čemu su oni s medicinskim obrazovanjem rjeđe podložni utjecaju medija u vezi s cijepljenjem djece. Značajna razlika ne postoji prema razini obrazovanja, mjestu stanovanja, broju djece u obitelji, učestalosti cijepljenja i pojavi komplikacija cijepljenja, razlozima negativnog stava kao ni prema iskustvu drugih roditelja.

Zaključak: Medicinski obrazovani roditelji imaju veće znanje o cjepivima i mogućim komplikacijama kod cijepljenja, češće konzultiraju struku te su manje podložni utjecaju medija, ali neovisno o tome podjednako su skeptični u pogledu koristi od cijepljenja svoje djece.

**Ključne riječi**: cijepljenje, djeca, obrazovanje roditelja, stavovi roditelja

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# RADIOLOGICAL WORKUP OF SPINE TRAUMA

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## ABSTRACT

Introduction: imaging plays an important role in the treatment of patients with spinal trauma. Until a final diagnosis is made, the first imaging method is X-ray diagnostics, then CT and finally MRI diagnostics for spinal cord injuries. The aim of this paper is to investigate how radiological methods can help in the precise diagnosis and monitoring of patients with spinal injury, and which radiological diagnostic method is the most effective.

Research methodology: data collection time: from 1.1. 2023 to 1.1. 2024 at the University Clinical Hospital Mostar, Department of Radiology. The subjects are patients with spinal trauma who were referred for radiological treatment at the University Clinical Hospital Mostar during the mentioned time period.

Results: The youngest subject was 7 years old, and the oldest was 83 years old. The mean age of the subjects was 49.4 years. The majority of subjects were in the age groups 60-69 and older than 70 years, both groups 23%. The most common injury was a rib fracture, in 27% of subjects, acetabular fracture in 23% of subjects, and cervical spine fracture in 21%. Of the total number of subjects, 49% had a lumbar spine injury, 30% a thoracic injury and 21% a cervical spine injury. The most common type of imaging was CT, 38% 33% of subjects had X-ray imaging and 29% MRI imaging.

Conclusion: CT is the first imaging modality due to its fast and easy acquisition and high sensitivity for detecting bone fractures. New technologies in the field of CT, especially DECT and photon-counting CT, have managed to increase the sensitivity for detecting spinal trauma. MRI provides detailed information about ligaments, soft tissues, disc and spinal cord.

**Keywords**: spine trauma, radiological diagnostics

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## INTRODUCTION

The spine plays a crucial role in maintaining the body's upright posture in relation to the action of gravity and receives, attenuates and distributes sudden compressive and tensile loads caused by the constant kinetics of the body. Its role is also important in protecting the spinal cord and the associated nerve roots located in the spinal canal (1). The paravertebral musculature, which consists of the deep muscles of the back, is also important for the stability of the spine (2). After completing the clinical examination, radiological examinations of the spine are ordered, if necessary.

Routinely and for orientation, the spine is imaged in two directions: anteroposterior (AP) and laterolateral (LL).

If there is a spinal deformity, the degree of its deformation is determined by AP and LL images. It is also a good idea to take a vertebrogram of the entire spine, from which the balance of the spine is analyzed, i.e. the intersegmental impact of the pathological process on the spine is analyzed.

Electromyoneurography and nerve conduction velocity measurement are often used in the treatment of cervicocephalic syndrome. Transcranial magnetic resonance imaging is often used to assess the vascularity of the vertebrobasilar artery. Doppler ultrasound of the vertebral artery (Transcranial Cervical Doppler - TCD), then MR angiography of the neck and sometimes selective spinal angiography to determine the blood supply to the spinal cord, bone elements and paravertebral structures (3).

In emergency cases, the appropriate choice of imaging for spinal trauma depends on several factors such as the availability of modalities, the clinical and neurological status of the patient, the type of trauma (blunt, single or multiple trauma), and other associated comorbidities.

In the rare circumstances when CT is not available, the initial imaging modality is radiography. A minimum of lateral and anteroposterior views for the spinal axis should be obtained with the addition of an open-mouth odontoid view for the cervical spine. Additional views such as oblique views and/or swimmer's view are often performed in an attempt to clear the cervicothoracic junction. With the exception of pediatric trauma, radiography has been replaced by CT in most settings (4).


**Figure 1.** *X-ray of the lumbar spine*
*(Source: Croatian Hospital "Dr. Fr. Mato Nikolić" Nova Bila; Radiology Department)*

Computed tomography (CT) is the preferred method for evaluating the cervical spine for bony injuries following blunt trauma. The entire spinal axis can be reliably and expeditiously assessed with automatic reshaping of the axial data set into multiple planes, allowing for better and more accurate diagnosis of bony and soft tissue abnormalities. Moreover, in the case of polytrauma, images of the spine can be reconstructed directly from the chest, abdomen, and pelvis data sets with sensitivity equivalent to that of a dedicated spine CT scan. This has the added advantage of minimizing radiation dose (5).

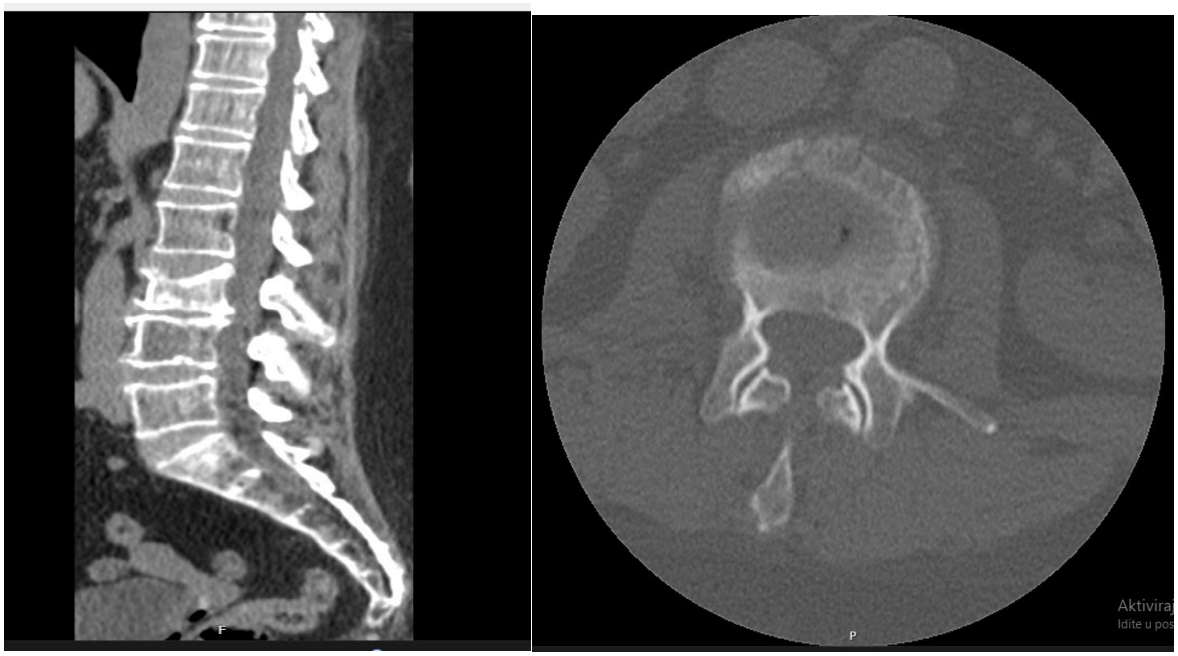

**Figure 2.** *(a) Sagittal and (b) axial CT views showing a burst fracture of L3 with significant retropulsion of the vertebral body into the spinal canal and loss of body height.*
*(Source: Croatian Hospital "Dr. Fr Mato Nikolić" Nova Bila; Radiology Department)*

MRI is now considered the method of choice for evaluating the spectrum of soft tissue injuries associated with spinal trauma. This includes damage to the intervertebral discs, ligaments, vascular structures, and spinal cord. No other imaging modality has been able to faithfully reproduce the internal architecture of the spinal cord, and this is a special feature that is unique to MRI. Any patient who has persistent neurological deficits after spinal trauma should undergo MRI in the acute period to exclude direct damage/compression of the spinal cord.

MRI provides indisputable evidence not only of spinal cord injury, but will also reliably show disc injuries/herniations, paraspinal soft tissue edema (ligamentous sprain /rupture), epidural hematomas, and vascular injuries. In addition, MRI provides the most reliable assessment of chronic spinal cord injury and imaging analogues of posttraumatic progressive myelopathy, which often presents with imaging findings such as syrinx formation, myelomalacia, and cord atrophy. The extent to which MRI can detect spinal instability is overestimated because MRI cannot provide a reliable assessment of ligamentous integrity in most cases. In fact, MRI falsely overestimates the soft tissue component of the injury (6).

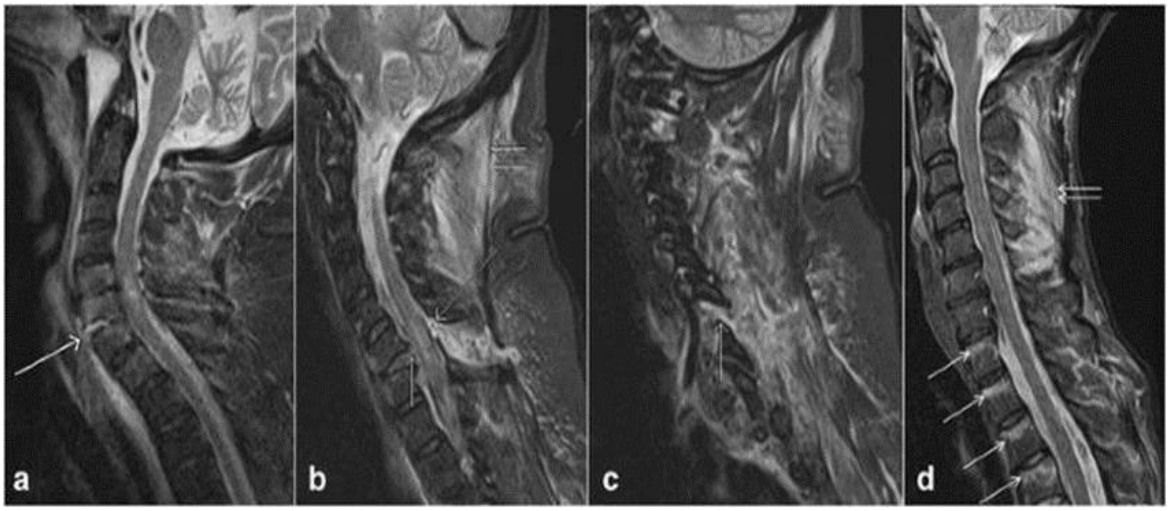


**Figure 3.** *Picture of tau inversion recovery (STIR) images show complete rupture of the anterior longitudinal ligament (arrow, a), complete rupture of the posterior longitudinal ligament (short single arrow, b) and ligamentum rupture flavum (long arrow, b), rupture of the nose ligamentum (short double arrow) arrows, b), injury to the facet capsule (arrow, c) and injury to the interspinous ligament (short double arrows, d).*
*(Source: https://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s12891-0161169-6)*

The MRI protocol for the cervical spine in acute spinal trauma includes sagittal T1 (T1-weighted) and T2-weighted (T2W) and short tau inversion recovery (STIR) sequences of 3 mm thickness and axial T2-weighted gradient echo (GRE) images without contrast. In the thoracic and lumbar spine, sagittal T1-weighted, T2-weighted and STIR sequences of 4 mm thickness and axial T1-weighted, T2-weighted and T2 GRE images of 4 mm thickness without contrast are recommended. 3D volumetric axial GRE or T2-weighted slices of 1–2 mm thickness are useful in the cervical region. Fat-saturated T2-weighted images are valuable for the evaluation of ligamentous and soft tissue injuries, and T2 GRE for the evaluation of small hemorrhages or blood products in the spinal cord (6).

## Injuries to the vertebral column and spinal cord

Classically, spinal injuries are categorized by mechanism of injury and/or by instability. Instability is defined as an abnormal transfer between adjacent vertebral segments with normal physiologic motion. Unrecognized instability after trauma is a potential cause of delayed spinal cord injury. Therefore, early stabilization of the initial injury is imperative for appropriate clinical management. The simplest method of testing for instability in a controlled environment is to perform lateral flexion and extension radiographs to produce a visible subluxation at the suspected level, but this is rarely performed in practice.

The mechanism of injury will result in several different types of traumatic injuries to the cervical, thoracic, and lumbar vertebrae and spinal cord, which can result in stable or unstable spinal injuries (7).

Due to the distinct anatomical differences and resulting injury patterns, cervical spine injuries are divided into subaxial injuries (base of skull to axis) and lower cervical injuries (C3–C7). The mechanism of cervical spine injury can be divided into

four major groups: hyperflexion, hyperextension, rotation, and vertical compression with frequent variations involving components of the major groups (e.g., flexion and rotation).

The most common fracture, at the thoracolumbar junction, is a simple compression or wedge fracture (50% of all fractures) which is considered stable. The remaining types of fractures among them are the so-called seat belt injuries, which can be divided into three subtypes: type I (Chance fracture) involves the posterior bony elements, type II (Smith fracture) involves the posterior ligaments and, in type III, the annulus fibrosus ruptured, allowing subluxation and are considered unstable fractures (8).

Whiplash-associated disorders (WAD) is a clinical diagnosis and describes a variety of clinical manifestations, such as neck pain immediately or 24 hours after trauma, neck stiffness, headache, dizziness, vertigo, hearing and vision disturbances, concentration and psychological problems. Imaging findings include bony injuries such as bone contusions and occult fractures, ligament injuries (the most common finding) and tears. Disc lesions and post-traumatic herniation may also occur. MRI signal changes in the alar and transverse ligaments may be observed. Whether these signal abnormalities are responsible for the complaints of patients with WAD remains controversial, as these signal abnormalities have also been observed in asymptomatic individuals and have not been significantly associated with clinical testing and prognosis of acute whiplash injury. A recent meta-analysis could not demonstrate any association between MRI signal changes in the alar and transverse ligaments and WAD (9).

## RESEARCH METHODOLOGY

The research is prospective qualitative. Purposive sampling. The data collection time was in the period from January 1, 2023 to January 1, 2024 at the University Clinical Hospital Mostar, Department of Radiology. The respondents were patients with spinal trauma who were radiologically and diagnostically processed in the aforementioned Department. For statistical data processing, the following programs were used: SPSS, Excel.

## RESULTS

A total of 73 subjects who had spinal trauma participated in the study for the period from January 1, 2023 to January 1, 2024.

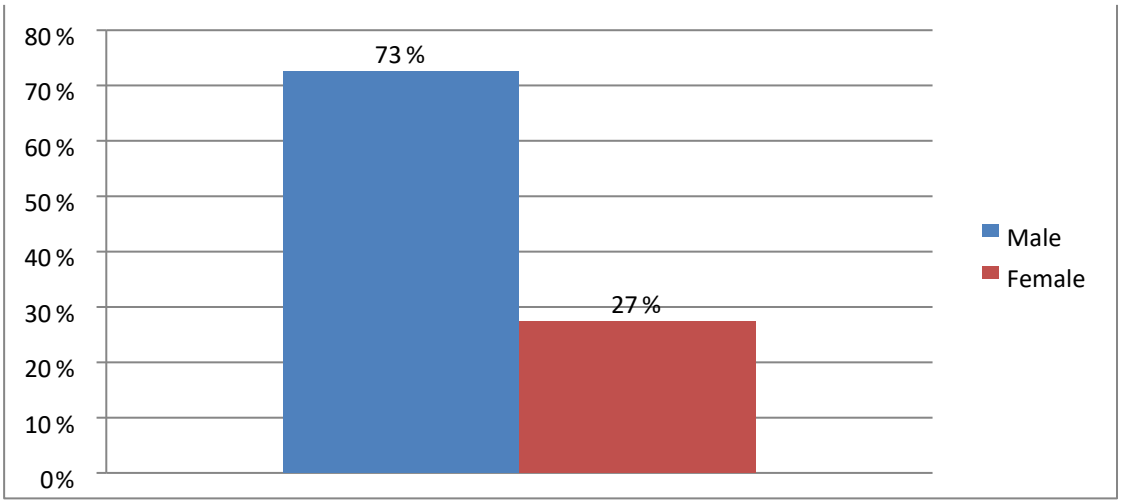


**Chart 1.** *Gender distribution of respondents*

73% of male respondents and 27% of female respondents participated in the study.

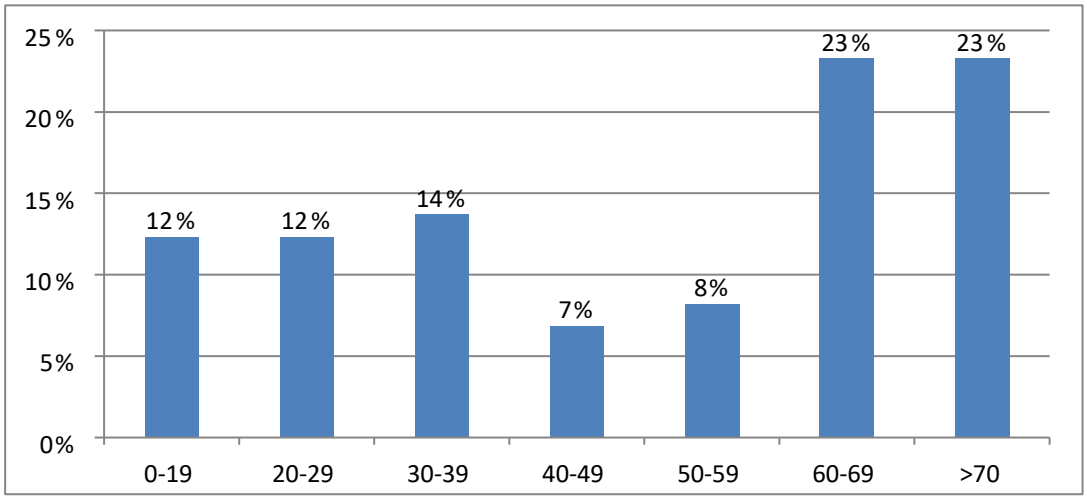


**Chart 2.** *Age distribution of respondents*

The youngest respondent was 7 years old, and the oldest was 83. The median age of respondents was 49.4 years old. The largest number of respondents were in the age groups 60-69 and over 70, both groups 23%. There were 14% of respondents in the age group 30-39, 12% each in the age groups 0-19 and 20-29. The age group 50-59 had 8% of the total number of respondents, and the smallest number was in the age group 40-49, 7%.

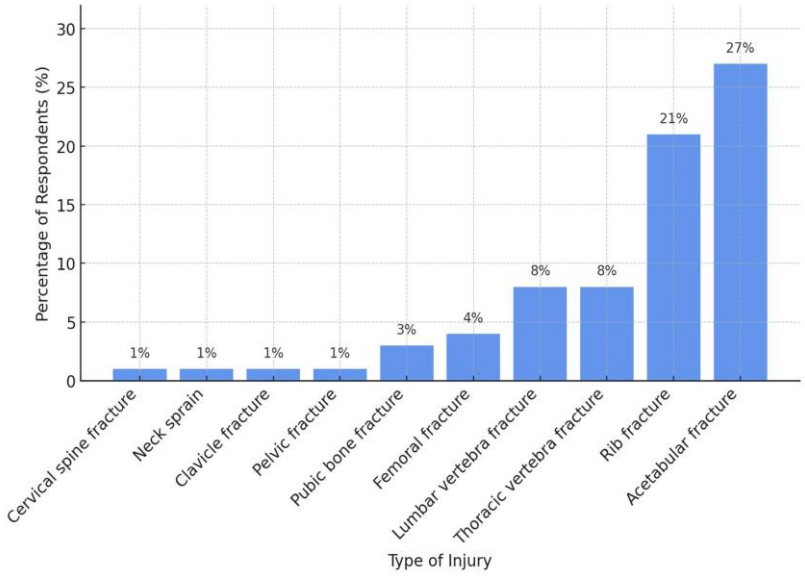


**Chart 3.** *Distribution of respondents by type of trauma*

The most common injury was a rib fracture, in 27% of the subjects, an acetabular fracture in 23% of the subjects, and a cervical spine fracture in 21%.

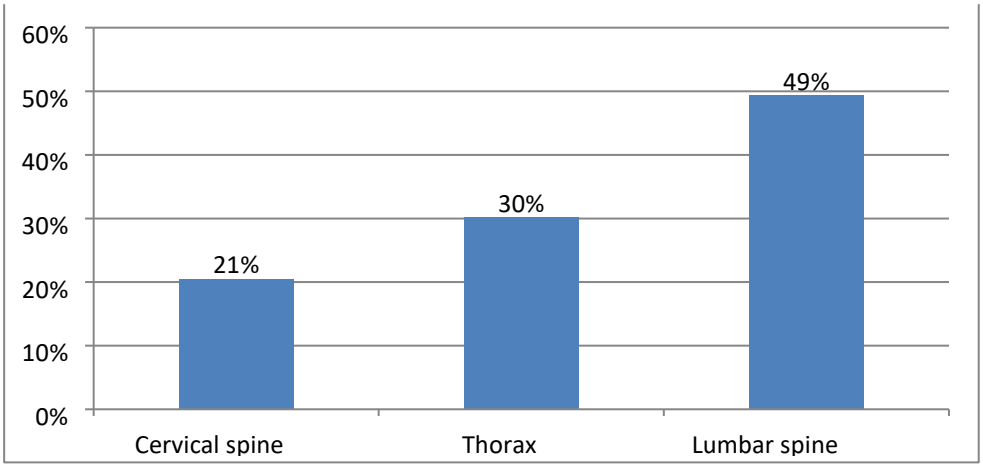


**Chart 4.** *Distribution of respondents according to spinal injury*

Of the total number of respondents, 49% had a lumbar spine injury, 30% a thoracic spine injury and 21% a cervical spine injury.

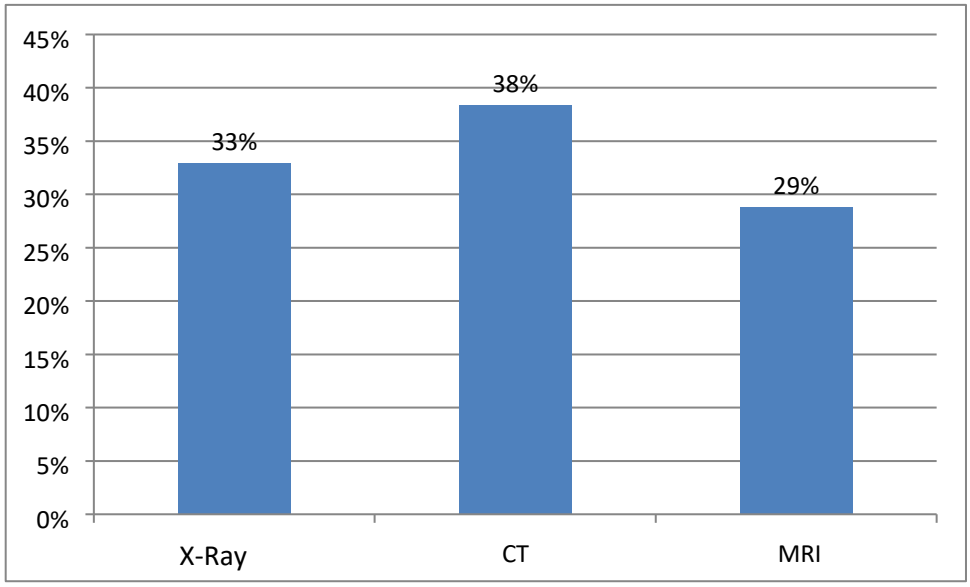


**Chart 5.** *Distribution of respondents by type of recording*

The most common type of imaging was CT, 38% 33% of respondents had X-ray imaging and 29% MRI imaging.

## DISCUSSION

Plain radiography is appropriate to obtain adequate radiographs in cases where the patient is at low risk of injury, CT will be skipped unless there is a risk of more serious injury, or in children. However, plain radiographs miss a significant proportion of injuries due to poor image quality, inadequacy as demonstrated by the lack of craniocervical and/or cervicothoracic junctions in the field of view, or inaccurate interpretation of the image by the clinician (10,11).

A study of 1577 trauma patients, where all patients underwent plain radiography in five views (anteroposterior, lateral, odontoid, and right and left oblique views) and helical CT scanning, showed that plain radiographs failed to identify 299/416 fractures (72%) detected on CT (12).

The growing evidence against plain radiography suggests that this option should only be used in areas where CT is not available or in children where exposure to medium to high levels of ionizing radiation is contraindicated.

Where CT is not available, a high-quality five-view plain radiograph with visualization of all seven vertebrae, preferably reviewed by a radiologist, is recommended.

In a study of patients with minor injuries with normal neurologic status and CT findings, 21% of patients with persistent central cervical tenderness had a cervical disc/ligament injury detected on MRI that warranted clinical treatment with a cervical collar (18%) or operative stabilization (3%). Advanced cervical spondylosis was strongly associated with the severity of injury in these patients (13).

In addition to providing details of bony anatomy, CT scanning can detect significant soft tissue abnormalities such as traumatic disc herniations and significant epidural or subdural hematomas in the spinal canal. The trend toward the use of CT as the primary imaging modality is illustrated in a study by Shabaniya et al.

They conducted a study in six regions worldwide, and found that in neurologically intact patients with spinal trauma, CT was the predominant imaging modality for all regions ( 14 ).

CT imaging is not without its problems, and in addition, image acquisition artifacts such as metal artifacts, beam hardening, scattering, and ring artifacts can occur. A combination of advances in mathematics and technology has made it possible to reduce these artifacts. For example, photon-counting CT has been shown to reduce beam hardening artifacts while increasing spatial resolution. In addition, CT does not determine the severity of spinal cord injury, nor does it help to assess the prognosis of the injury (15).

MRI is currently considered the gold standard imaging modality for the evaluation of patients with spinal cord injury and spinal trauma (16).

MRI has multiplanar capabilities with high contrast resolution and can therefore provide information on spinal cord compression, ligamentous instability, disc herniation, contusions and hemorrhage as well as injuries to the vertebral bodies and paraspinal tissues (17).

In a review by Sliker et al. (2005) in patients with blunt trauma, the authors reported a 22.7% detection rate of ligamentous injury by MRI, of which 80.8% required treatment (18).

Despite the time required to perform MRI, it is still recommended in the pre- and postoperative phases when feasible. Not only is MRI considered safe, when protocols are followed, it also directly influences the clinical decisions of the surgeon (19).

The main disadvantage of MRI imaging is the time it takes to obtain the scan.

## CONCLUSION

The youngest respondent was 7 years old, and the oldest was 83 years old. The average age of respondents was 49.4 years old. The largest number of respondents was in the age groups 60-69 and over 70 years old, both groups 23%. There were 14% of respondents in the age group 30-39 years, 12% each in the age groups 0-19 and 20-29 years. The age group 50-59 years had 8% of the total number of respondents, and the smallest number was in the age group 40-49 years, 7%.

The most common injury was a rib fracture, in 27% of the subjects, an acetabular fracture in 23% of the subjects, and a cervical spine fracture in 21%. Of the total number of subjects, 49% had a lumbar spine injury, 30% a thoracic injury and 21% a cervical spine injury. The most common type of imaging was CT, 38% 33% of the subjects had an X-ray and 29% an MRI.

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# RADIOLOŠKA OBRADA TRAUME KRALJEŽNICE

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## SAŽETAK

Uvod: u liječenju bolesnika s traumom kralježnice slikovna snimanja imaju važnu ulogu. Do postavljanja konačne dijagnoze, prva metoda oslikavanja je rendgenska dijagnostika, zatim CT i u konačnici MRI dijagnostika za ozljede leđne moždine. Cilj ovog rada je istražiti kako radiološke metode mogu pomoći u preciznoj dijagnozi i praćenju pacijenata s ozljedom kralježnice, te koja je radiološko-dijagnostička metoda najučinkovitija.

Metodologija istraživanja: vrijeme prikupljanja podataka: od 1.1. 2023. do 1.1. 2024. godine na Sveučilišna klinička bolnica Mostar, Zavod za radiologiju. Ispitanici su pacijenti s traumom kralježnice koji su upućeni na radiološku obradu SKB Mostar u spomenutom vremenskom periodu.

Rezultati: najmlađi ispitanik imao je 7 godina, a najstariji 83 godine. Srednja dob ispitanika je 49,4 godine. Najviše ispitanika nalazilo se u dobnim skupinama 60-69 i starijih od 70 godina, obje skupine po 23%. Najčešća ozljeda bila je prijelom rebara, kod 27% ispitanika, prijelom acetabula imalo je 23% ispitanika, te prijelom vratne kralježnice njih 21%. Od ukupnog broja ispitanika, 49% imalo je ozljedu lumbalne kralježnice, 30% ozljedu grudnog koša i 21% ozljedu vratne kralježnice Najčešća vrsta snimanja bio je CT, 38% 33% ispitanika imalo je RTG snimanje i 29% MR snimanje.

Zaključak: CT je prvi modalitet snimanja zbog svoje brze i jednostavne akvizicije i visoke osjetljivosti za otkrivanje prijeloma kostiju. Nove tehnologije u području CT-a, posebice DECT i CT s brojanjem fotona, uspjele su povećati osjetljivost za otkrivanje traume kralježnice. MRI pruža detaljne informacije o ligamentima, mekim tkivima, disku i leđnoj moždini.

**Ključne riječi**: trauma kralježnice, radiološka dijagnostika

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# VARIABILITY AND DIFFERENCES IN EMPATHY, SELF-EFFICACY, AND ACADEMIC SUCCESS AMONG STUDENTS IN MEDICAL FIELDS WITH REGARD TO EDUCATIONAL STAGE AND PRACTICAL TRAINING

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## ABSTRACT

Introduction: Education in the medical field combines theoretical knowledge, practical skills, and personal competencies such as empathy, self-efficacy, and academic success, which are essential for healthcare work. Practical training enables the development of technical, emotional, and social competencies, contributing to academic success.

Aim: To examine the variability and differences in empathy, self-efficacy, and academic success levels among students of the Medical School and the Undergraduate Nursing Program, with a focus on the presence of practical training.

Participants and Methods: This research was conducted as a quantitative descriptive and comparative study, involving students from the Medical School Dubrovnik (n = 82) and students from the Undergraduate Nursing Program at the University of Dubrovnik (n = 68). The General Self-Efficacy Scale, Emotional Empathy Scale, and a sociodemographic questionnaire were used. Data were analyzed using non-parametric tests (Mann-Whitney U test and Kruskal-Wallis test for analyzing differences, with significance levels p = 0.01 and p = 0.05) in IBM SPSS (version 20).

Results: Students in the Undergraduate Nursing Program showed higher self-efficacy and academic success compared to Medical School students, while empathy levels were similar, with greater variability among nursing students. Participants with practical classes showed higher levels of all variables, confirming the importance of practical experience. Differences in empathy, self-efficacy, and academic success based on educational level and practical classes were statistically significant.

Conclusion: Educational stages and specific programs result in differences in variables, but practical experience further develops these skills, contributing to better preparation for professional challenges. Curriculum improvements are necessary for greater effectiveness in healthcare education.

**Keywords:** empathy, self-efficacy, academic success, students, practical training

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## INTRODUCTION

Education in the medical profession represents a complex process that requires the integration of theoretical knowledge, practical skills, and personal competencies essential for performing healthcare activities. In this context, traits such as empathy and self-efficacy play a crucial role in the professional development of future healthcare workers. The connection between these traits and academic success, as well as their development through practical training, is often highlighted as a priority area in research on educational processes in medical education.

Empathy, defined as the ability to understand and appreciate the emotions, experiences, and perspectives of others, is one of the fundamental qualities of healthcare professionals. It enables better communication with patients, increases trust, and contributes to higher quality healthcare delivery (1). Research indicates that empathy can be developed during education, particularly through practical training that provides direct contact with patients and real clinical situations (2). However, the level of empathy may vary depending on the intensity of practical experiences and the stage of education, with a decline in empathy often observed in the later phases of medical training due to exposure to stress and increased responsibility (3).

In addition to empathy, self-efficacy referring to an individual's belief in their own ability to successfully perform a specific task is a significant factor in both academic and professional success. Bandura (1997) emphasizes that a high level of self-efficacy enhances motivation, perseverance, and resilience to stress, which is of great importance for students in medical education (4). Practical training allows students to apply theoretical knowledge in clinical situations, thereby strengthening their sense of competence and confidence in performing professional tasks (5).

Academic achievement, as a measure of accomplishment in an educational context, encompasses both theoretical knowledge and the ability to apply it in practical settings. In medical schools, practical training plays a key role in linking theoretical knowledge with clinical skills, and research indicates that high-quality practical training has a positive impact on students' motivation and academic achievement (6).

Practical training is not only an opportunity for technical development, but also for the emotional and social growth of students. Direct contact with patients, facing the challenges of healthcare, and working in teams foster the development of empathy, strengthen self-efficacy, and enhance communication skills (7). However, differences in the intensity and quality of practical training between secondary and higher medical education, as well as among students with varying levels of experience, open space for exploring its impact on key variables.

The aim of this research is to examine the variability and differences in the levels of empathy, self-efficacy, and academic achievement among students of a Medical School and Undergraduate Nursing Program students, with a focus on the presence of practical training.

## PARTICIPANTS AND METHODS

### Participants

The sample included in this research consists of two target groups of participants from medical education institutions. The first group comprises students from the Medical School Dubrovnik, with a total of 98 participants (59.0%), while the second group includes 68 participants (41.0%) from the Undergraduate Nursing Program at the University of Dubrovnik.

The research was conducted in October 2024. Participants were selected based on their educational level within the medical field, with the aim of analyzing differences in the variables of empathy, self-efficacy, and school/academic achievement in relation to the level of education and the presence of practical training.

### Methods

The research utilized the General Self-Efficacy Scale developed by Schwarzer and colleagues (1997), which measures a general and stable sense of personal efficacy in coping with a variety of stressful situations (8). The scale consists of 10 items and is characterized by high internal consistency, with reliability coefficients ranging between 0.75 and 0.90. In Croatian samples, Cronbach's alpha ranges between 0.853 and 0.874, while the test-retest reliability was 0.743 (9,10).

The scale is positively associated with optimism, satisfaction with academic success and studies, and negatively associated with anxiety and pessimism, making it suitable for assessing self-efficacy in students of medical education. The total score is calculated as a linear combination of item ratings.

The Emotional Empathy Scale developed by Raboteg-Šarić (1991, 1993) measures the tendency for emotional reactions triggered by the emotional state of others. The scale contains 19 statements that describe emotional experiences corresponding to the emotional state of others, as well as feelings of sympathy for those in distress. The highest possible score is 76 points, with a higher score indicating a greater tendency to experience emotional empathy (11).

In addition, the questionnaire included general sociodemographic questions (gender, grade, academic achievement, and practical training).

The questionnaires were completed anonymously, electronically, with prior informed consent obtained, and the average time to complete them was 15 minutes. The collected data was coded and prepared for further statistical analysis.

### Statistical Data Analysis

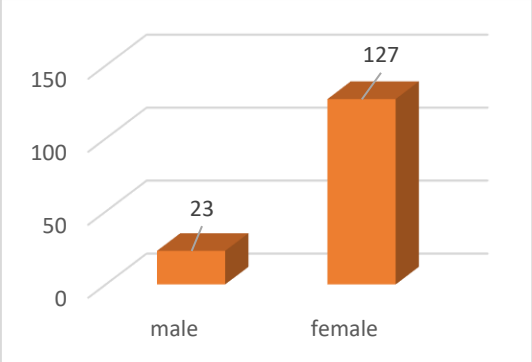
The analysis of the results was conducted using IBM SPSS Statistics software (version 20), employing both descriptive and inferential statistical methods. Given the assessment of the normality of the data distribution, non-parametric tests were chosen. To examine differences in levels of empathy and general self-efficacy based on the level of education and the presence of practical training, the Mann-Whitney U test was used, while differences in school/academic achievement were analyzed using the Kruskal-Wallis test. Statistical significance was assessed at the levels of $p = 0.01$ and $p = 0.05$.

## RESULTS

### Sociodemographic Characteristics of Participants

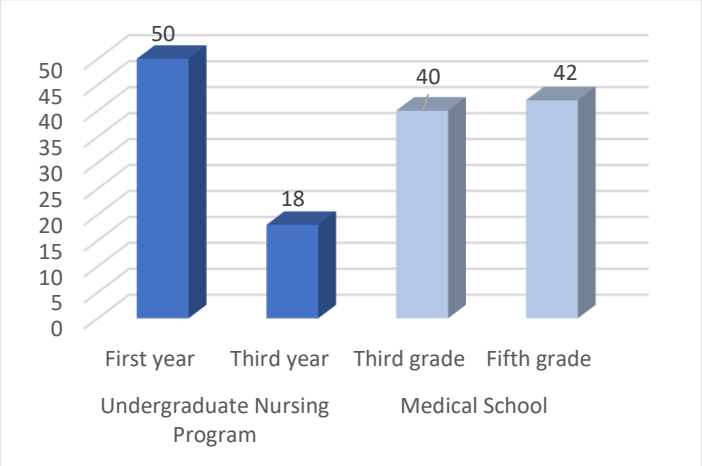
The study included 150 participants, the majority of whom were women (84.6%, n = 127), while 15.3% (n = 23) were men. (Figure 1)

**Figure 1.** *Gender Distribution of the Sample*



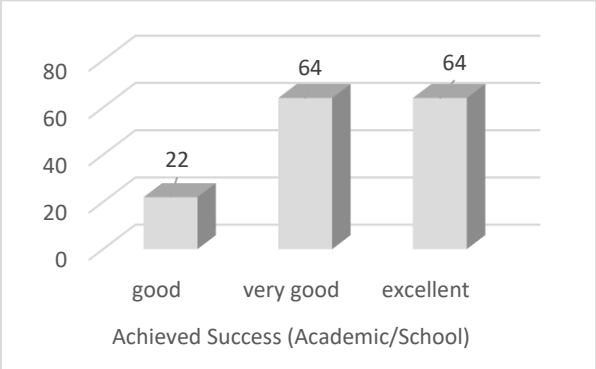

Participants were distributed according to their level of education, with a total of 82 participants from the Medical School and 68 students from the Undergraduate Nursing Program. Among the secondary school students, 48.8% (n = 40) were in third grade, and 51.2% (n = 42) were in their fifth grade. At the university level, 30.1% (n = 50) of the participants were in their first year of the nursing program, and 10.8% (n = 18) were in their third year. (Figure 2)

**Figure 2.** *Educational Level Distribution of the Sample*



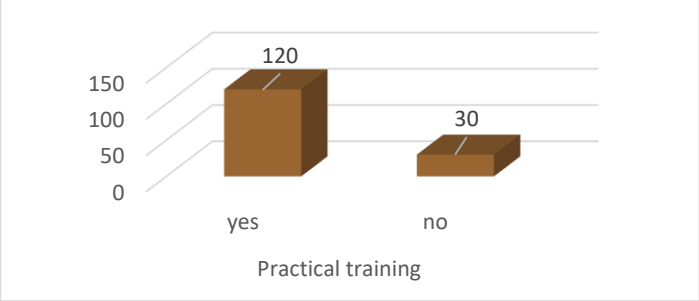

The academic/school achievement of the participants was very good, as no participant had a grade of "sufficient" or "insufficient." (Figure 3) Of the total number of participants, 14.8% (n = 22) had a good achievement, 42.6% (n = 64) had a very good achievement, and 42.6% (n = 64) had an excellent achievement.

**Figure 3.** *Achievement Distribution of the Sample*




In terms of practical training, the majority of participants (80%, n = 120) had experience with practical training, while 20% (n = 30) had not participated in it.

**Figure 4.** *Sample Distribution Based on Participation in Practical Training*




## Descriptive Statistical Indicators of Empathy, Self-Efficacy, and Academic Achievement of Participants from Different Education Levels

The data from Table 1 indicate that participants from the Undergraduate Nursing Program achieved scores on the empathy scale ranging from 32 to 75, with a mean value of 58.85, suggesting a moderate to high level of empathy, with significant variability in the results (SD = 11.386). On the self-efficacy scale, scores ranged between 31 and 50, with a mean score of 41.90 and lower variability (SD = 5.261), indicating a more stable sense of self-efficacy among the participants. Academic achievement was rated with an average value of 4.43 on a scale from 3 to 5, indicating a high level of achievement with relatively low variability in the results (SD = 0.642). These findings suggest generally high performance among participants across all examined domains.

**Table 1.** *Descriptive Statistical Indicators of Empathy, Self-Efficacy, and Academic Achievement of Participants from the Undergraduate Nursing Program*

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Empathy | 68 | 32 | 75 | 58.85 | 11.386 | -.474 | .246 | -.776 | .488 |
| Self-Efficacy | 68 | 31 | 50 | 41.90 | 5.261 | -.149 | .244 | -.777 | .483 |
| Academic Achievement | 68 | 3 | 5 | 4.43 | .642 | -.681 | .244 | -.515 | .483 |

According to the data from Table 2, participants from the Medical School achieved results on the empathy scale ranging from 42 to 70, with an average score of 57.29 and a standard deviation of 6.995, indicating a high level of empathy with moderate variability in the results. On the self-efficacy scale, the scores ranged from 28 to 50, with an average of 38.26 and a standard deviation of 4.715, suggesting a slightly lower, but still satisfactory, level of self-efficacy. The academic achievement was assessed with an average score of 4.03 on a scale from 3 to 5, with relatively low variability (SD = 0.753), indicating solid academic performance among the participants. These results reflect a generally good level of achievement across all examined domains. (Table 2)

**Table 2.** *Descriptive Statistical Indicators of Empathy, Self-Efficacy, and Academic Achievement of Participants from the Medical School*

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Empathy | 82 | 42 | 70 | 57.29 | 6.995 | -.675 | .291 | -.136 | .574 |
| Self-Efficacy | 82 | 28 | 50 | 38.26 | 4.715 | -.370 | .291 | .748 | .574 |
| Academic Achievement | 82 | 3 | 5 | 4.03 | .753 | -.049 | .291 | -1.207 | .574 |

## Descriptive statistical indicators of empathy, self-efficacy, and academic achievement of participants with practical training

The descriptive statistical indicators for participants who have practical training (Table 3) show a moderate level of empathy, with an average score of 57.13 (SD = 9.856). The range of scores is from 32 to 75, indicating moderate variation among the responses. Skewness (-0.583) indicates a slight shift towards higher scores, while kurtosis (-0.192) suggests a more even distribution. The self-efficacy of these participants is also high, with an average score of 40.70 (SD = 5.509). The range of scores from 28 to 50 indicates some variation among participants. The skewness value (-0.174) suggests slight symmetry in the distribution, while kurtosis (-0.131) shows a more even distribution of scores. The academic achievement of these participants is high, with an average grade of 4.28 (SD = 0.720). The range of grades goes from 3 to 5, with minimal variation in the results. Skewness (-0.480) indicates a slight shift towards higher grades, while kurtosis

(-0.950) suggests a broader distribution of grades. Accordingly, participants with practical training demonstrate a high level of empathy, self-efficacy, and academic achievement, with moderate variability among the results.

**Table 3.** *Descriptive Statistical Indicators of Empathy, Self-Efficacy, and Academic Achievement of Participants with Practical Training*

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Empathy | 120 | 32 | 75 | 57.13 | 9.856 | -.583 | .216 | -.192 | .428 |
| Self-Efficacy | 120 | 28 | 50 | 40.70 | 5.509 | -.174 | .214 | -.131 | .425 |
| Academic Achievement | 120 | 3 | 5 | 4.28 | .720 | -.480 | .214 | -.950 | .425 |

Descriptive statistical indicators for participants without practical training show slightly lower values compared to participants with practical training. On the empathy scale, the average score is 53.74 (SD = 9.664), with results ranging from 37 to 71. The skewness value (-0.503) indicates a slight shift towards higher values, while kurtosis (-0.640) shows a slightly wider data distribution. The average level of self-efficacy is 37.42 (SD = 4.654), with results ranging from 32 to 49. The skewness value (0.033) indicates an almost symmetric distribution of results, while kurtosis (-0.720) suggests a slightly wider distribution than normal. The academic achievement of these participants has an average grade of 4.21 (SD = 0.704), with results ranging from 3 to 5. Skewness (-0.321) shows a slight shift towards higher grades, while kurtosis (-0.878) indicates a broader distribution, meaning that grades are mostly distributed towards higher values. Overall, participants without practical training show solid levels of self-efficacy, empathy, and academic achievement, with slightly lower variability in the results compared to participants with practical training.

**Table 4.** *Descriptive Statistical Indicators of Empathy, Self-Efficacy, and Academic Achievement of Participants without Practical Training*

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Empathy | 30 | 37 | 71 | 53.74 | 9.664 | -.503 | .383 | -.640 | .750 |
| Self-Efficacy | 30 | 32 | 49 | 37.42 | 4.654 | .033 | .383 | -.720 | .750 |
| Academic Achievement | 30 | 3 | 5 | 4.21 | .704 | -.321 | .383 | -.878 | .750 |

## Differences in Empathy, Self-Efficacy, and Academic Achievement Among Participants with Different Levels of Education

The Mann-Whitney U test was used to analyze the differences in levels of empathy and self-efficacy between participants with different levels of education, specifically between students of the Undergraduate Nursing Program and Medical School students (Table 5). The results of the Mann-Whitney test for empathy show a significant difference between nursing students and high school medical students (p = 0.004). Nursing students have a higher mean rank (83.85) compared to high school medical students (70.59), indicating a higher level of empathy among nursing students. For self-efficacy, a significant difference was also found between nursing students and high school medical students (p = 0.000). Nursing students have a higher mean rank (95.79) compared to high school medical students (65.79), meaning that nursing students have a greater perception of their own self-efficacy compared to high school medical students.

**Table 5.** *Results of the Mann-Whitney Test for Determining Differences in Empathy and Self-Efficacy Between Participants with Different Levels of Education*

| | Levels of Education | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Wilcoxon W | Z | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|
| Empathy | Undergraduate Nursing Program | 68 | 83.85 | 8050.00 | 3134.000 | 5480.000 | -.435 | .004 |
| | Medical School | 82 | 70.59 | 5480.00 | | | | |
| Self-Efficacy | Undergraduate Nursing Program | 68 | 95.79 | 9387.00 | 2128.000 | 4474.000 | -3.966 | .000 |
| | Medical School | 82 | 65.79 | 4474.00 | | | | |

The Kruskal-Wallis test was used to analyze differences in academic achievement between participants of different education levels (Table 6). The results show a significant difference in academic achievement between participants from the Undergraduate Nursing Program and those from the Medical School (p = 0.001). Participants from the Medical School have a lower mean rank (69.38) compared to nursing students (93.30), suggesting that these students achieve lower academic results than nursing students.

**Table 6.** *Results of the Kruskal-Wallis Test for Identifying Differences in Academic Achievement Among Participants of Different Education Levels*

| | Educations Levels | N | Mean Rank | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|---|---|---|
| Achieved Success (Academic/School) | Undergraduate Nursing Program | 68 | 93.30 | 11.743 | 1 | .001 |
| | Medical School | 82 | 69.38 | | | |

## Differences in Empathy, Self-Efficacy, and Academic Success Based on Participation in Practical Training

The results of the Mann-Whitney test for empathy and self-efficacy indicate significant differences between respondents who have practical training and those who do not (Table 7). For empathy, respondents who have practical training (mean rank = 82.56) show a higher mean rank compared to respondents without practical training (mean rank = 62.29), and the test is statistically significant (p = 0.015). These results suggest that respondents with practical training have a higher level of empathy.

For self-efficacy, respondents with practical training (mean rank = 85.81) also show a higher mean rank compared to those without practical training (mean rank = 75.71), and the test is also significant (p = 0.024).

**Table 7.** *Mann-Whitney Test Results for Identifying Differences in Empathy and Self-Efficacy of Respondents Based on the Presence of Practical Training*

| | Practical Training | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Wilcoxon W | Z | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|
| Empathy | yes | 120 | 82.56 | 10403.00 | 2386.000 | 3127.000 | -.031 | .015 |
| | no | 30 | 62.29 | 3127.00 | | | | |
| Self-Efficacy | yes | 120 | 85.81 | 10984.00 | 2136.000 | 2877.000 | -1.141 | .024 |
| | no | 30 | 75.71 | 2877.00 | | | | |

The results of the Kruskal-Wallis test for academic performance show a significant difference between respondents who have practical training and those who do not. Respondents with practical training (mean rank = 84.63) show a higher mean rank compared to respondents without practical training (mean rank = 69.71), and the test is statistically significant (p = 0.047). (Table 8)

**Table 8.** *Results of the Kruskal-Wallis test for determining differences in academic performance of respondents based on the presence of practical training.*

| | Practical Training | N | Mean Rank | Chi-Square | df | Asymp. Sig. |
|---|---|---|---|---|---|---|
| Achieved Success | yes | 120 | 84.63 | 1.362 | 1 | .047 |
| | no | 30 | 69.71 | | | |

## DISCUSSION

Given the importance of understanding the psychological and educational factors that influence the success of students in health professions, this study focuses on analyzing the levels of empathy, self-efficacy, and academic success among high school medical students and nursing students, with a particular emphasis on the role of practical training in shaping these competencies. The results indicate that high school medical students exhibit a high level of empathy (M = 57.29), while nursing students show a moderately high level of empathy (M = 58.85), with greater variability among the results. In terms of self-efficacy, Medical School students have a slightly lower average level (M =

38.26) compared to nursing students, who demonstrate moderately high self-efficacy (M = 41.90). Academic achievement is slightly lower among high school medical students (M = 4.03) compared to nursing students, who achieve a higher average grade (M = 4.43). These findings suggest that nursing students have somewhat higher self-efficacy and academic success than high school medical students, while their levels of empathy are similar, with greater variability observed among nursing students. These results may reflect specificities in the educational context and level of education: nursing students, due to their higher level of education and possibly more intensive engagement in practical training, develop a stronger sense of self-efficacy and achieve slightly better academic outcomes. However, the lower variability in empathy levels among Medical School students may reflect a more standardized approach to teaching and the homogeneity of students' experiences at this level of education.

Respondents who have practical training demonstrate high self-efficacy, empathy, and academic success, with moderate variability among the results. This supports the theory that practical experience in education, particularly in healthcare professions, has a significant impact on the development of emotional and cognitive skills. Previous studies indicate that students who have access to practical training tend to achieve better academic outcomes and develop a higher degree of professional empathy and efficiency in performing their tasks (12). Practical experience allows students to apply theoretical knowledge in real-life situations, enhancing their perception of personal efficacy and fostering the development of their emotional competencies. For the respondents who do not have practical training, the results show high levels of self-efficacy, empathy, and academic success, with slightly lower variability compared to those with practical training. Although these respondents also exhibit high levels of confidence and success, the lower variability may suggest limited application of theoretical knowledge in real-life situations, which could be attributed to the lack of practical experience. This finding may also reflect different learning styles among students, where those without practical training may rely on other forms of learning, such as simulations or theoretical workshops.

Interestingly, students from the Undergraduate Nursing Program have a higher average rank in self-efficacy compared to Medical School students, which could point to specific factors related to the academic program and the support nursing students receive. This finding aligns with research suggesting that high academic demands and learning challenges can increase students' perception of their own efficacy (13).

When academic achievements are compared, students from the Medical School show lower results compared to students from the Undergraduate Nursing Program. This may be related to the different teaching methods and curriculum differences between these educational programs. It is possible that nursing study programs provide a greater amount of structured tasks and assessments, which help students achieve more stable and consistent academic results.

The results for academic/school success showed a significant difference between participants who had practical training and those who did not. Participants who had practical training had a higher average rank, which is consistent with previous research suggesting that practical experience can positively affect academic outcomes. Practical training not only allows students to develop their professional skills but also increases their motivation and engagement in learning, which directly reflects in their academic performance (14).

In general, these results confirm the importance of practical training in education, particularly in healthcare fields, and highlight the significance of developing emotional and cognitive competencies that are crucial for successful professional development.

Although the study provides valuable insights, there are certain limitations that may restrict the generalizability of the results. The first limitation pertains to the sample size, as the research was conducted on a relatively small number of participants, limited to one Medical School and one Undergraduate Nursing Program, which may reduce its representativeness for a broader population. Additionally, the self-assessment method used to measure empathy and self-efficacy may be subject to subjective biases, which could affect the accuracy and reliability of the results. Participants may have a tendency to rate themselves more favorably than they actually are, especially in socially desirable skills such as empathy. Furthermore, the short-term nature of the study may limit our understanding of the long-term effects of practical training and emotional skills on professional development and work efficiency.

For future research, it is recommended to expand the sample to include students from other healthcare and non-medical disciplines, which would allow for a better understanding of how different educational stages shape emotional skills and academic performance. Longitudinal studies tracking the development of emotional skills, such as empathy and self-efficacy, throughout education and into the professional environment would be valuable to assess their impact on long-term professional success. Additionally, it would be useful to employ mixed methods, combining self-assessments with objective measures, such as mentor evaluations or work performance assessments, to ensure greater precision and reliability of the data. Furthermore, future studies could explore specific educational strategies, such as simulation methods or virtual learning, and their impact on the development of emotional skills and academic achievements.

## CONCLUSION

This research makes a significant contribution to understanding how different educational frameworks and experiences (such as practical training) influence the development of emotional skills and academic achievements among students in healthcare programs. The first key finding of this research indicates that participants exposed to practical training exhibited higher levels of empathy and self-efficacy, which are important for their later professional application in healthcare institutions. Furthermore, the differences in self-efficacy levels between secondary

Medical School students and Ungraduate Nursing Program students highlight the importance of subjective perceptions of one's effectiveness, which can impact motivation, learning, and ultimately success in both education and professional life. These findings can serve as a foundation for improving educational methods and curricula, with the aim of further developing emotional skills that are crucial for success in healthcare professions.

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# VARIJABILNOST I RAZLIKE U EMPATIJI, SAMOEFIKASNOSTI I POSTIGNUTOM USPJEHU UČENIKA I STUDENATA MEDICINSKOG SMJERA OBZIROM NA OBRAZOVNU FAZU I PRAKTIČNU NASTAVU

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## SAŽETAK

Uvod: Obrazovanje u medicinskoj struci kombinira teorijska znanja, praktične vještine i osobne kompetencije poput empatije, samoefikasnosti i akademskog uspjeha, koji su ključni za rad u zdravstvu. Praktična nastava omogućuje razvoj tehničkih, emocionalnih i socijalnih kompetencija, čime doprinosi akademskom/školskom uspjehu.

Cilj: Ispitati varijabilnost i razlike u razini empatije, samoefikasnosti i akademskog uspjeha kod učenika Medicinske škole i studenata Preddiplomskog studija sestrinstva, s naglaskom na prisutnost praktične nastave.

Ispitanici i metode: Istraživanje je provedeno kao kvantitativno deskriptivno i komparativno, obuhvaćajući učenike Medicinske škole Dubrovnik (n = 82) i studente Preddiplomskog studija sestrinstva Sveučilišta u Dubrovniku (n = 68). Korišteni su upitnici Skale opće samoefikasnosti, Skale emocionalne empatije i sociodemografski upitnik. Podaci su analizirani neparametrijskim testovima (Mann-Whitney U test i Kruskal-Wallis test za analizu razlika, s razinama značajnosti p = 0,01 i p = 0,05) u IBM SPSS-u (verzija 20).

Rezultati: Studenti Preddiplomskog studija sestrinstva pokazali su višu samoefikasnost i postignuti akademski uspjeh od učenika Medicinske škole, dok su razine empatije bile slične, uz veću varijabilnost među studentima sestrinstva. Ispitanici s praktičnom nastavom pokazali su višu razinu svih varijabli, što potvrđuje važnost praktičnog iskustva. Razlike u empatiji, samoefikasnosti i postignutom uspjehu s obzirom na razinu obrazovanja i praktičnu nastavu pokazale su se statistički značajnim.

Zaključak: Obrazovne faze i specifični programi donose razlike u varijablama, ali praktično iskustvo dodatno razvija ove vještine, čime doprinosi boljoj pripremljenosti studenata za profesionalne izazove. Potrebno je unaprijediti kurikulum za veću učinkovitost obrazovanja u zdravstvenim strukama.

**Ključne riječi:** empatija, samoefikasnost, akademski uspjeh, učenici, studenti, praktična nastava

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# THE INFLUENCE OF VASOACTIVE DRUGS ON THE OCCURRENCE OF PRESSURE ULCERS IN THE SURGICAL INTENSIVE CARE UNIT

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## ABSTRACT

Background: A pressure ulcer (pressure injury) occurs when tissue loading and/or loading duration exceeds individual tissue tolerance. Risk factors for pressure ulcer development include mobility/activity limitations, skin condition, perfusion, circulation, oxygenation, moisture/microclimate, age, and diet. Patients in the intensive care unit (ICU) have additional risks for the development of pressure ulcers, such as the use of vasoactive drugs, prolonged treatment in the ICU, the presence of comorbidities (diabetes, cardiovascular diseases, hypotension), prolonged mechanical ventilation, hemodialysis and sedation, which confirms the complex nature of pressure ulcer development.

The aim: To examine the influence of vasoactive drugs on the incidence of pressure ulcers in the surgical intensive care unit.

Subjects and methods: The subjects were all patients with pressure ulcers treated in the surgical ICU, Clinic for Anesthesiology, Resuscitation, Intensive Care and Pain Therapy, University Hospital Center Zagreb over a 3-year period. All subjects were assessed for pressure ulcer risk using the Braden scale.

Results: The incidence of pressure ulcers was 5.7%, with no significant differences in gender or age. The most common risk factors included pressure, friction, traction, hypotension, and anemia. In most subjects, the pressure ulcer occurred in the ICU, formed in the sacrum, gluteal, and ischial regions, and was observed in stage II. Vasoactive drugs were used in all subjects. Noradrenaline was most commonly used.

Conclusion: Vasoactive drugs were used in all subjects, which indicates their association with decubitus. In future research, it is necessary to specify the dose, the time of application, to study each individual vasoactive drug, their synergistic effects, and to include all patients treated in the ICU, in order to examine the difference between patients with/without pressure ulcers with regard to the use of vasoactive drugs.

**Key words:** pressure ulcer, vasoactive drugs, Braden scale, intensive care unit.

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## INTRODUCTION

Pressure ulcers (pressure injuries) develop when tissue loading and/or duration of loading exceeds the individual tissue tolerance (1). The European Pressure Ulcer Advisory Panel (EPUAP) defines pressure ulcers as localized damage to the skin or subcutaneous tissue caused by pressure, shear or friction forces, or a combination thereof (2). Risk factors for pressure ulcer development include mobility/activity limitations, skin status, perfusion, circulation, oxygenation, humidity/microclimate, age and nutrition (1). Patients in the ICU have additional risks for pressure ulcer development, such as the use of vasoactive drugs, prolonged ICU treatment, the presence of comorbidities (diabetes, cardiovascular disease, hypotension), prolonged mechanical ventilation, haemodialysis and sedation, which confirms the complex nature of pressure ulcer development (3). Pressure ulcers, although preventable, today represent a significant problem for both the patient and his family (pain, longer hospitalization, reduced quality of life, economic costs), and for the healthcare system (need for greater resources – increased treatment costs). Globally (204 countries), the number of prevalent cases of pressure ulcers in 2019 was 0.85 million (4). Age-standardized prevalence rates were 11.3 per 100,000 population, and incidence was 41.8 per 100,000 population. The global prevalence rate of pressure ulcers increases with age, peaking in the age group 80 to 84 years for men and 85 to 89 years for women, with decreasing patterns in older age groups. In the last 30 years, global age-standardized incidence and prevalence rates have decreased (with significant regional differences), although pressure ulcers still represent a significant global health problem (4). No consolidated data were found for the incidence and prevalence of pressure ulcers in Croatia; different studies have reported different incidence rates of pressure ulcers ranging from 0.4 to 38% (5). Huljev et al. report that the incidence of pressure ulcers in hospitalized patients reaches 38%, and in patients treated in the ICU 33% (6). According to another source, the incidence of pressure ulcers in seriously ill patients treated in the ICU ranges from 3.3% to 53.4%, with a prevalence ranging from 13.1% to 45.5% (7).

Knowledge of risk factors for pressure ulcer development enables the identification of patients at increased risk, which enables timely provision of preventive measures (8). A systematic review of articles in the Cochrane Library, CINAHL, MEDLINE and Embase databases, from January 2008 to September 2022, identified 37 risk factors for pressure ulcer development in hospitalized adult patients, among which the main risk factors were diabetes, length of surgery or length of stay in the ICU, use of vasoactive drugs and low hemoglobin levels. Other risk factors included: the presence of comorbidities (anemia, cancer, cardiovascular disease, diabetes, kidney disease, respiratory disease, and others), older age, increased body mass index, type of hospital admission, use of certain medications (sedatives, steroids, vasoactive drugs), low nutritional status, skin status, surgical factors (number of operations, duration of surgery), use of medical devices, mobility, presence of force, pressure, traction, pain, low blood pressure, and poor tissue oxygenation (9).

Patients admitted to the ICU are at higher risk for developing pressure ulcers compared to patients admitted to general hospital wards. Patients treated in the ICU have the highest rates of hospital-acquired pressure ulcers, which often develop due to the presence of serious illnesses, immobility, and medical interventions. They are associated with longer ICU stays and increased mortality (7). No single risk factor for developing pressure ulcers can explain the occurrence of pressure ulcers in the ICU. Multiple risk factors contribute to the development and progression of pressure ulcers, which are often life-threatening and worsen (14). Some studies support the use of vasoconstrictors as a potential risk factor, but a synthesis of the available evidence is incomplete. In a systematic review by Tang et al. on the effects of vasoconstrictors on pressure ulcer development, pressure ulcers occurred in 10.9% of the population receiving vasoconstrictors and in 3.5% of the population not receiving them (8). It was found that the use of vasoconstrictors increased the risk of pressure ulcers in intensive care patients by almost twofold.

The aim of this study is to examine the influence of vasoactive drugs on the incidence of pressure ulcers in the surgical intensive care unit.

## SUBJECTS AND METHODS

### Procedures and participants

A cross-sectional study was conducted with historical dana. The subjects were 191 patients with pressure ulcers treated in the ICU for surgical patients, at the Clinic for Anesthesiology, Resuscitation, Intensive Care and Pain Therapy of the Clinical Hospital Center Zagreb, over a three-year period, from January 1, 2021 to December 31, 2023. Data were collected from the BIS, and a retrospective data analysis was applied. Data were collected on gender, age, underlying medical diagnosis, presence of comorbidities, present exogenous and endogenous risk factors for pressure ulcer development, assessment of risk for pressure ulcer development, time of pressure ulcer onset, stage of pressure ulcer at first observation and discharge, pressure ulcer localization, use of vasoactive drugs, and pressure ulcer treatment. Data were collected during April 2024. Approval was obtained from the ethics committee of the University Hospital Center Zagreb for the purposes of this study.

### Statistical analysis

Descriptive statistics methods were used in data processing. Categorical data are presented as absolute and relative frequencies. Numerical data are presented as arithmetic mean and standard deviation. Differences or associations between categorical variables were tested using the Chi-square test, and when necessary, Fisher's exact test. All P values are two-sided, and the significance level was set at 0.05. Statistical analysis was performed using the MedCalc software system (version 14.12.0, Med Calc Software bvba, Ostend, Belgium).

## RESULTS

### Sample description

In the three-year period, 191 patients with pressure ulcers were treated in the surgical ICU. Table 1 shows the number of patients with pressure ulcers treated in the surgical ICU in the individual years observed. The fewest subjects with pressure ulcers were in 2021 (5.19%), and the most in 2023

(6.29%). The incidence in the three-year period was 5.7%.

**Table 1.** *Number of patients with pressure ulcers treated in the surgical ICU*

| **Year** | **Number (%) of respondents** | |
|---|---|---|
| | **Total number of treated** | **Patients with decubitus ulcers** |
| 2021. | 1233 | 64 (5,19) |
| 2022. | 1007 | 57 (5,66) |
| 2023. | 1113 | 70 (6,29) |
| **Total** | 3353 | 191 (5,70) |

Table 2. shows the gender and age of the respondents. There were no statistically significant differences between the respondents with regard to gender and age, although there were slightly more men (52.88%) compared to women (47.12%) and slightly more respondents in the age group 65 to 74 years (31.41%) compared to the other observed age groups.

**Table 2.** *Gender and age of respondents*

| Demographic characteristics | | Number (%) of respondents | **P*** |
|---|---|---|---|
| Gender | Female | 90 (47,12) | 0,43 |
| | Male | 101 (52,88) | |
| Age | < 65 years | 42 (21,99) | 0,14 |
| | 65 – 74 years | 60 (31,41) | |
| | 75 – 84 years | 50 (26,18) | |
| | > 85 years | 39 (20,42) | |
| **Total** | | 191 (100,0) | |

* chi-square test

## Risk factor for ulcer formation

Table 3. shows the presence of endogenous risk factors for pressure ulcers. Hypotension 188 (98.43%) and anemia (59.69%) were present in statistically significant numbers of subjects (Chi square test, $P < 0.001$).

**Table 3.** *Endogenous risk factors for pressure ulcers*

| Endogenous risk factors for pressure ulcers | Number (%) of respondents | P* |
|---|---|---|
| Immobility | 65 (34,03) | |
| Incontinence | 78 (40,84) | |
| Malnutrition | 18 (9,42) | |
| Anemia | 114 (59,69) | |
| Hypotension | 188 (98,43) | |
| Neurological diseases | 19 (9,95) | **< 0,001** |
| Cardiovascular diseases | 49 (25,65) | |
| Diabetes | 53 (27,75) | |
| Disorders of consciousness | 54 (28,27) | |
| Fever | 3 (1,57) | |

* Chi-square test

Table 4. shows the time of onset of pressure ulcers. A statistically significantly higher number of subjects developed pressure ulcers in the ICU compared to subjects who developed them before admission to the ICU (78.53%:21.47%) (Chi square test, P < 0.001).

**Table 4.** *Time of onset of pressure ulcers*

| Time of onset of pressure ulcers | Number (%) of respondents | P* |
|---|---|---|
| Before admission to the ICU | 41 (21,47) | **< 0,001** |
| In the ICU | 150 (78,53) | |
| **Total** | 191 (100,0) | |

* Chi-square test

Vasoactive drugs were used in all subjects with pressure ulcers. 1 vasoactive drug was used in 115 (60.21%) subjects, 2 in 53 (27.75%) subjects, 3 in 19 (9.95%) subjects, and 4 in 3 (1.57%) subjects. Table 5. shows the vasoactive drugs used. Statistically, the most commonly used drug was noradrenaline, in 190 (99.48%) subjects (Chi square test, P < 0.001).

**Table 5.** *Vasoactive drugs used*

| Vasoactive drugs used | Number (%) of respondents | P* |
|---|---|---|
| Adrenaline | 20 (10,47) | |
| Noradrenaline | 190 (99,48) | **< 0,001** |
| Vasopressin | 50 (26,18) | |
| Dobutamine | 32 (16,75) | |

* Chi-square test

Table 6. shows a comparison of the stage of pressure ulcers at discharge with respect to the number of vasoactive drugs administered. No statistically significant association was observed between the number of vasoactive drugs administered and the stage of pressure ulcers (Chi square test, P = 0.41).

**Table 6.** *Comparison of pressure ulcer stages at discharge with respect to the number of vasoactive drugs administered*

| **Stages of pressure ulcers at discharge from the ICU** | Number (%) of respondents | | | **P*** |
|---|---|---|---|---|
| | **1 drug** | **2 drugs** | **3 drugs** | |
| Stage I | 23 (27,06) | 4 (18,18) | 0 (0,0) | 0,41 |
| Stage II | 43 (50,59) | 14 (63,64) | 5 (62,50) | |
| Stage III | 14 (16,47) | 3 (13,64) | 2 (25,0) | |
| Pressure ulcer of unknown depth | 1 (1,18) | 0 (0,0) | 1 (12,50) | |
| Suspicion of deep tissue injury | 3 (3,53) | 1 (4,54) | 0 (0,0) | |
| No pressure ulcers | 1 (1,18) | 0 (0,0) | 0 (0,0) | |
| **Total** | 85 (73,91) | 22 (19,13) | 8 (6,96) | |

* Chi-square test

## DISCUSSION

The results of a study on the influence of vasoactive drugs on the occurrence of pressure ulcers in the surgical intensive care unit of the Clinical Hospital Center Zagreb over a three-year period showed a low incidence (5.7%), which is within the range established by previous studies. In this study, there were no statistically significant differences in the gender and age of the subjects, which was also established by previous studies (4, 14). Patients treated in the ICU are known to have the highest rates of hospital-acquired pressure ulcers. The incidence of pressure ulcers in the ICU ranges from 3.3% to 53.4% (10). Results vary depending on the methodology and study site. A study conducted in 90 countries in 1117 ICUs reported a prevalence of pressure ulcers acquired in the ICU of 16.2% (12). In a study by de Oliveira Ramalho et al., the incidence of pressure ulcers in the ICU in patients with Covid-19 was 30.2% (13). In a global study of pressure ulcer incidence and prevalence, there were no significant differences by gender (6). In a study of pressure ulcer prevention strategies in adult acute care settings in the United States in 2018/2019, there were equal numbers of men (50%) and women (49.4%) and 0.6% of unknown gender, with a mean age of 64.29 years (14).

In this study, among endogenous risk factors, hypotension and anemia were present in a statistically significant number of subjects, which confirms the findings of previous studies (9, 13).

In this study, the majority of subjects developed pressure ulcers in the ICU compared to subjects who developed them before admission to the ICU, confirming that the ICU is a place of treatment and care with an increased risk for developing

pressure ulcers compared to other hospital settings (7). The risk assessment for pressure ulcers using the Braden scale was performed in all subjects.

In this study, vasoactive drugs were used in all subjects. 60.21% of subjects used 1 drug, 27.75% used 2 drugs, 19.95% used 3 drugs, and 1.57% used 4 vasoactive drugs. The most commonly used drug was noradrenaline, either alone or in combination with vasopressin. From the above, it can be concluded that the use of vasoactive drugs is associated with the development of pressure ulcers. Vasopressor infusion is commonly administered to patients in intensive care to improve perfusion in shock, with consequent peripheral vasoconstriction, which may pose a risk for the development of pressure ulcers (15). Pressure ulcers have been shown to be associated with the use of vasoactive drugs (16), and vasopressor infusion has been shown to independently predict the development of pressure ulcers (17, 18). The exact mechanism by which vasoactive drugs may influence the development of pressure ulcers is unclear. Critically ill patients may experience hemodynamic changes during turning, leading to conditions such as cardiac arrest, and the use of vasoactive drugs may exacerbate hemodynamic instability. For this reason, nurses/technicians may reduce the frequency of turning patients who are receiving vasoactive drugs. They constrict peripheral blood flow to maintain blood flow to vital organs, thereby reducing peripheral blood flow and increasing the risk of developing pressure ulcers (19). Vasopressors are difficult to study because of the variability in their effects on peripheral circulation related to the dose delivered and the receptors targeted (13). Future studies should specify the dose, time of administration, study each individual vasoactive drug separately, and consider their synergistic effects. In this study, no statistically significant association was observed between the number of vasoactive drugs administered and the stage of pressure ulcers, probably because only patients with pressure ulcers were included. Future studies should include all patients treated in the ICU, in order to examine the difference between patients with and without pressure ulcers with regard to the use of vasoactive drugs.

## CONCLUSIONS

The incidence of pressure ulcers in the three-year period in the surgical ICU was low (5.7%). There were no statistically significant differences between the subjects with respect to gender and age, although there were slightly more in the age group 65 to 74 years (31.42%) compared to the other observed age groups. Of the endogenous risk factors, hypotension and anemia were statistically significantly more common in the majority of subjects.A statistically significantly higher proportion of subjects developed pressure ulcers in the ICU (78.53%) compared to subjects who developed pressure ulcers before admission to the ICU (21.47%). Vasoactive drugs were used in all subjects. 60.21% of subjects used 1 drug, 27.75% of subjects used 2 drugs, 19.95% of subjects used 3 drugs, and 1.57% of subjects used 4 vasoactive drugs. Statistically, the most commonly used drug was noradrenaline, either alone or in combination with vasopressin.

In future research, it is necessary to specify the dose, time of administration,

specifically study each individual vasoactive drug, their synergistic effects, and include all patients treated in the ICU, in order to examine the difference between patients with and without pressure ulcers with respect to the use of vasoactive drugs.

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# UTJECAJ VAZOAKTIVNIH LIJEKOVA NA POJAVU DEKUBITUSA U JEDINICI KIRURŠKOG INTENZIVNOG LIJEČENJA

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## SAŽETAK

Uvod: Dekubitus (ozljeda od pritiska) nastaje kada opterećenje tkiva i/ili trajanje opterećenja premašuje individualnu toleranciju tkiva. Čimbenici rizika za razvoj dekubitusa uključuju ograničenja pokretljivosti/aktivnosti, stanje kože, perfuziju, cirkulaciju, oksigenaciju, vlagu/mikroklimu, dob i prehranu. Bolesnici u jedinici intenzivnog liječenja (JIL) imaju dodatne rizike za razvoj dekubitusa, kao što su primjena vazoaktivnih lijekova, produljeno liječenje u JIL-u, prisutnost komorbiditeta (dijabetes, kardiovaskularne bolesti, hipotenzija), produljena mehanička ventilacija, hemodijaliza i sedacija, što potvrđuje kompleksnu prirodu razvoja dekubitusa.

Cilj: Ispitati utjecaj vazoaktivnih lijekova na incidenciju dekubitusa u jedinici intenzivnog kirurškog liječenja.

Ispitanici i metode: Ispitanici su bili svi bolesnici s dekubitusom liječeni na kirurškoj JIL-u Klinike za anesteziologiju, reanimatologiju, intenzivno liječenje i liječenje boli KBC-a Zagreb tijekom 3 godine. Svim ispitanicima je procijenjen rizik od dekubitusa pomoću Bradenove ljestvice.

Rezultati: Učestalost dekubitusa bila je 5,7%, bez značajnih razlika u spolu i dobi. Najčešći čimbenici rizika uključivali su pritisak, trenje, trakciju, hipotenziju i anemiju. Kod većine ispitanika, dekubitus se pojavio u JIL-u, formirao se u sakrumu, glutealnoj i ishijalnoj regiji, a uočen je u stadiju II. Kod svih ispitanika korišteni su vazoaktivni lijekovi. Najčešće se koristio noradrenalin.

Zaključak: Kod svih ispitanika korišteni su vazoaktivni lijekovi, što ukazuje na njihovu povezanost s dekubitusom. U daljnjim istraživanjima potrebno je precizirati dozu, vrijeme primjene, proučiti svaki pojedini vazoaktivni lijek, njihove sinergističke učinke, te obuhvatiti sve bolesnike liječene u JIL-u, kako bi se ispitala razlika između bolesnika s/bez dekubitusa s obzirom na primjenu vazoaktivnih lijekova.

**Ključne riječi:** dekubitus, vazoaktivni lijekovi, Bradenova ljestvica, jedinica intenzivnog liječenja.

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# COMPUTER-AIDED DIAGNOSIS AND DETECTION IN CHEST RADIOGRAPHY

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## SUMMARY

Artificial intelligence (AI) is a computer science that deals with the ability of computers and robots to perform tasks that require some form of intelligence, such as learning, planning, object recognition, understanding foreign languages, etc. It is applied in various fields such as medicine, science, finance, entertainment, security.

Artificial intelligence is slowly but surely being integrated into the healthcare system, where it aims to improve patient outcomes, reduce costs, and increase efficiency. It has a special role in the field of radiology, where it should increase diagnostic and therapeutic accuracy.

Different types of artificial intelligence that have found application in radiology are machine learning, deep learning, and neural networks. Radiological imaging data is growing rapidly and increasing the need for the number of available trained radiologists. Artificial intelligence makes the radiologist's job easier by reducing the time needed for diagnosis, but also serves as a support for diagnosis and interpretation of findings. Artificial intelligence systems play a special role in chest radiography. Chest radiography uses a computer program for pattern recognition that detects suspicious features in the image and brings them to the attention of the radiologist in order to reduce false negative readings. Computer-aided diagnosis or CAD is the name of the mentioned computer program. CAD systems, known as computer-aided detection (CADe) and computer-aided diagnostics (CADx), are based on the principle of deep learning, i.e. convolutional neural network (CNN). The aim of this paper is to point out the role of CAD systems in the accuracy and acceleration of diagnostic decision-making by radiologists in radiography of thoracic organs.

**Keywords:** Computer-aided diagnosis, radiology, detection, chest radiography

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## INTRODUCTION

With the development of technology in the last 10 to 15 years, medicine has also developed exponentially. We could not even imagine the healthcare system and medicine nowadays, without highly developed computer equipment. Since computer equipment and a large amount of information from various fields of medicine are everyday things, artificial intelligence has the potential to increase the efficiency of healthcare. The development of radiological equipment, although it leads to faster and better quality work, increases the amount of findings and information that radiologists need to interpret. Storing large number of data, stronger and faster computers, faster diagnosis, and deep and machine learning algorithms are some of the possibilities offered by artificial intelligence (1). The application of artificial intelligence in medicine could also create more time for doctor-patient interaction and make the patient a clinical point-of-care (POC). Artificial intelligence recognizes subtle changes that the human eye may miss. Recognizing lesions at an early stage can increase the accuracy of diagnosis.

The development of artificial neural networks has been traced throughout history since the mid-20th century. In the 1940s, Warren McCulloch and Walter Pitts published a scientific paper in which they proposed the use of a neural network as a way to imitate the human brain. In the 1950s, Minsky and Dean Edmunds produced a stochastic neural calculator that is recognized as the first neural network in history. A few years later, the first artificial intelligence programs were produced. In the late 1950s, Arthur Samuel accelerated the development of artificial intelligence by introducing the concept of machine learning. In the 1960s, research was conducted to identify the fundamental problems of artificial intelligence. Joseph Weizenbaum also developed an artificial intelligence program called ELIZA. ELIZA enabled humans to communicate with machines in English, thus demonstrating that a machine is able to communicate with humans on a superficial level without self-awareness or deep understanding of the person within the communication (2).

Today, the goal of artificial intelligence in medicine, especially in radiology, is to increase diagnostic and therapeutic accuracy. Artificial intelligence could tackle systemic problems in healthcare systems, such as long waiting times, diagnostic errors, inadequate access to specialist care in remote areas (rural areas, islands), a system of diagnostic criteria based on population (statistical) averages instead of individual health status, etc. (3).

The aim of this paper is to explain in more detail the concept of artificial intelligence in radiology, to define the different types of artificial intelligence implemented in radiology, and the mode of operation and benefits of artificial intelligence in radiology, especially in chest radiography. The second part of the paper discusses artificial intelligence systems derived from various radiological databases and their accuracy in interpreting findings. This document uses literature from scientific articles, books and research in clinical and non-clinical settings.

## ARTIFICIAL INTELLIGENCE SYSTEMS

Artificial intelligence (AI) is a very basic term that encompasses general AI (or strong AI) and narrow AI (highly specialized or weak AI). Speculations in

domain of science fiction, fall into the category of projections of general AI, not narrow AI, but they have greatly influenced the perception of most of the public about the status of the discipline's current progress, with symptomatic periods of enthusiasm and disillusionment with it (4).

In technical and medical contexts, one always speaks in narrow AI, which is not a single "artificial intelligence" but a series of algorithms whose capabilities do not superimpose – an algorithm that has learned to recognize images cannot understand language, and if it has learned to classify intestinal lesions based on colonoscopy videos, it will not be able to classify respiratory diseases), therefore any further mention of "artificial intelligence" refers to an "artificial intelligence algorithm". Narrow AI consists of symbolic AI and machine learning. Symbolic AI is considered obsolete. Machine learning consists of traditional machine learning and deep learning. Machine learning encompasses methods that use mathematical operations to process input data, resulting in predictions. Deep learning is a subtype of machine learning that learns directly from raw, unstructured data (e.g., language, images, video) that assumes a different model structure (in the form of neural networks) that is capable of "learning" independently and in layers – first building a rough view of the problem, and then fine-tuning and becoming more faithful to the real representation (5). Neural networks, the main structure within deep learning, basically search for the best set of model parameters that will describe a given phenomenon using an iterative optimization process. Deep learning is currently in the spotlight due to recent advances in vision systems based on convolutional neural networks, natural language processing (NLP), and generative (GAN) architectures, but classical machine learning methods are often sufficient for everyday challenges, which are, in fact, more robust and interpretable than neural networks. The main types of machine learning are: supervised, unsupervised, semi-supervised, reinforcement and deep learning. In supervised learning, the model uses data as input on which regions of interest are manually marked (in the case of medical data, they are marked by doctors, e.g. the location of a pneumothorax, a collapsed lung, on chest X-rays). Unsupervised learning takes unmarked data as input, while semi-supervised learning uses a combination of marked and unmarked data. Reinforcement learning uses a system of rewarding and punishing the model to take useful and unhelpful actions. It is useful to note that deep learning is also considered only a subset of machine learning (6). According to Zhang et al. (7), deep learning models are divided into discriminative models whose output is a class (they distinguish between features and perform classification), representative models whose output is a data representation (they extract features from data), and generative models whose output is a new data sample (they generate new and reconstruct from old data). Neural networks, the main structure within deep learning, are types of computer networks that build their systems similar to the architecture of the central nervous system for solving tasks and problems. When it comes to input data that are images, including medical images, convolutional neural networks are used. The emergence of convolutional neural networks has significantly increased the adaptability and robustness of computer

vision systems (vision systems), which previously depended on rigid rule-based approaches to image processing and could not learn from raw data, but each application required prior extraction of image features or attributes (feature extraction). In addition to medical images obtained for diagnostic purposes, an interesting source of image data are recordings of entire surgical operations, most often collected for the purpose of educating residents and specialists. Operations usually have a strictly defined protocol that can be described in steps, therefore, research into the applications of neural networks has included the problem of recognizing individual phases of operations, such as a study published in 2020 in the journal Nature on the example of laparoscopic cholecystectomy (8).

It is useful to note that from the point of view of machine and deep learning algorithms, there are differences in the processing of static (e.g. X-ray) and dynamic images (e.g. a recording of a surgical operation). In the first case, it is a simple image type of data for which convolutional neural networks are used, and in the second, a time series type of data in which each image is linked to a specific moment in time (the links between previous and subsequent images must be maintained in order for the display to make sense), for which recursive neural networks are best suited (9). The basic difference between convolutional and recursive neural networks (RNN) is in their architecture - CNN uses feed-forward, and RNN uses a recursive (repetitive) approach in which the output of parts of the network is fed back into the network as an input, i.e. the network works in a loop (3). Important features of deep neural networks are activation functions, such as a rectified linear unit (ReLU). The general structure of a convolutional neural network consists of inputs (radiological image), convolutional layers, compression layers, one-dimensional fully coupled layers, and outputs -classification of the radiological image (Figure 1) (10).

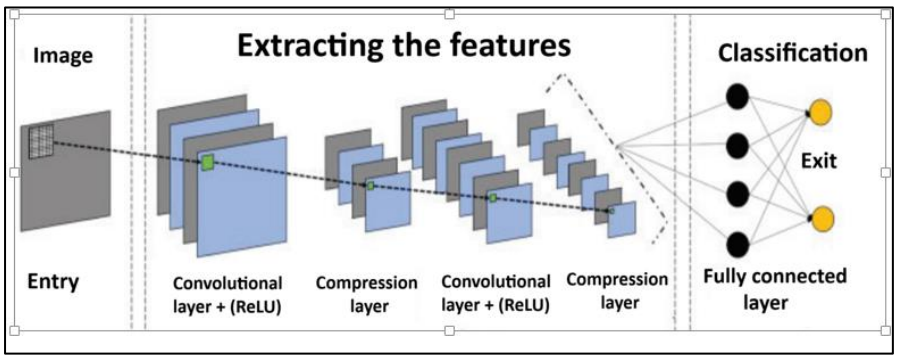


**Figure 1.** *Process of radiological image classification using deep neural networks technique (10).*

## ARTIFICIAL INTELLIGENCE IN RADIOLOGY

The primary driver of AI in radiology is the desire for greater efficiency and effectiveness in clinical care. Radiological imaging data is growing rapidly and increasing the need for trained radiologists. These factors have contributed to a dramatic increase in the workload of radiology. An integrated AI component within the imaging workflow would increase efficiency, reduce errors, and

achieve goals with minimal manual input by providing trained radiologists with pre-rendered images and identified features. Almost all image-based radiology tasks depend on the quantification and evaluation of radiographic features from images. These features may be important to the clinical task, such as the detection, characterization, or monitoring of disease (11).

In radiological image analysis, artificial intelligence systems are commonly used to target lesions in an image. For example, deep learning methods are used to classify lung nodules on a CT image and classify them as benign or malignant. A large amount of data with appropriate labels is required for efficient classification. In lung nodule classification, CT images of lung nodules and their labels as benign or malignant are used for training. After training the neural network, it can be implemented in decision support systems to detect lesions in radiological images.

## SEGMENTATION

Segmentation of organs or anatomical structures is a fundamental technique in radiological image processing. It most often uses parameters such as organ volume and shape. Classification depends on good segmentation of the organ, or lesion of interest. The segmentation system most often receives the entire image directly and displays the segmentation result. The training data for the segmentation system consists of radiological images containing the organ or structure of interest and the final segmentation result. The segmentation results are usually obtained by previously performed manual segmentation methods. Since the entire image is input to the segmentation system, the system must capture the entire spatial connectivity in the image for more efficient segmentation. Segmentation can be performed using a classifier, a convolutional network to calculate the probability of the organ or anatomical structure. In this approach, the segmentation process is divided into two steps. The first step creates a probability map of the organ or anatomical structure using a convolutional network and image layers. The second step uses map building refinement where the image content and the probability maps of the structures are used and merged. One previous study used a convolutional network classifier to segment the liver on CT images. A layer of images collected from the entire CT images was used as input for the convolutional network. A convolutional network calculated the probability of the liver from the image layers. By calculating the probability of the presence of the liver in the images, a 3D map of the liver probability was obtained. The results reveal that the approach is efficient and accurate for estimating liver volume under operational conditions. The high correlation between automatic and manual interpretation indicates that the method may be good enough for possible implementation in a system (12-14).

## CHEST RADIOGRAPHY

In chest radiography, a computer program for pattern recognition is used to detect suspicious features in the image and bring them to the attention of the radiologist in order to reduce false negative readings. Computer-aided diagnosis which consists of CADe and CADx systems is the name of the aforementioned computer program. CADe are systems designed to locate lesions on medical imaging. CADx systems perform actions such as

characterization of lesions (the difference between benign and malignant tumors). The radiologist reviews the image, then activates the CAD systems and re-evaluates the areas marked by the CAD before making a final decision. Numerous studies have shown that radiographic abnormalities are not always detected on the images, despite their presence. This problem is solved by selectively using strategies such as double readings, which contribute to increasing cancer detection rates. The goal of CAD systems is to reduce and prevent false negative findings due to observational errors. The advantage of using computers is also a reduced workload for the radiologist. CAD algorithms are designed to search for the same features that the radiologist searches for during the case review, CAD systems are mostly divided into image processing, region of interest extraction, region of interest feature extraction, and disease classification by features (15, 16).

Chest radiography has an important clinical value in the diagnosis of diseases, as it is one of the most common examinations in medical practice. The development of AI combined with the accumulation of a large amount of radiological images opens up new possibilities for building CAD systems. The overlapping of tissue structures on chest radiographs increases the complexity of interpretation. Lesion detection is challenging when the contrast between the surrounding tissue and the lesion is low or when the lesion is covered by, for example, ribs or large blood vessels. Therefore, there will be a certain degree of missed detection of pulmonary diseases on chest radiographs. A CAD system can help physicians detect missed suspicious lesions, thereby improving the accuracy of their detection.

A large database is essential for successful training of the system, and today there are large and publicly available databases of chest X-ray images. They differ in the number of different conditions that the images contain, and in the way the images are annotated (e.g., some are intended only for training systems that recognize pneumonia, while others are intended for training systems that recognize a wide range of different conditions). Most of the systems that are popular today are trained on one of these databases (16).The most significant and largest of these databases are: ChestX-ray14 (17), CheXpert (18), MIMIC-CXR (19), PadChest (20).

In order to make it easier for the model to draw conclusions from X-ray images, they are improved using various methods before being passed through the model, i.e., their information content is somehow enhanced. Some of these methods (21, 22), often used in the works, are: improving the quality of the images (increasing the contrast means increasing the difference between the lighter and darker parts of the image, thus making the entire image and some smaller objects on it clearer and more visible. Reducing the "noise" in the image is also carried out, during which the amount of data that is not useful information is reduced, while preserving this useful information as much as possible. Various techniques for manipulating the black and white spectrum are used to make the edges of objects in the image appear clearer. The images are also passed through various filters designed specifically to maximize the quality of such images); segmentation (segmentation identifies parts of the image that represent certain objects, for example the heart and lungs. This allows, for

example, atelectasis or pulmonary nodules to be searched only in parts of the image where they can appear, which are the lung fields). Segmentation can improve analysis and facilitate diagnosis by allowing the radiologist to focus on specific parts of the image; bone suppression (since bones cover a large part of the surface in which objects need to be recognized, it is useful to eliminate them from the image by various methods. In many cases, the presence of bones can interfere with the visualization of soft tissues or other anatomical structures. Shadow suppression techniques, such as specific contrast adjustments or the use of different imaging modalities (e.g., using MRI instead of CT), can help reduce the impact of bones on image quality.

The functionality of the CAD system is divided into the following sections: image processing, Region of Interest (ROI) extraction, description of morphological features and classification of diseases. CAD systems first process input images to improve quality and clarity, thereby facilitating further analysis. This process may include techniques such as filtering, significant contrast enhancement, and noise removal. After image processing, the systems identify areas of interest that require further analysis. This may include the detection of lung nodules, changes in parenchymal structure, or abnormalities in the mediastinum. CAD systems collect data on the morphological features of identified pathological conditions. These features may include size, shape, density, and other relevant characteristics that help in assessing the nature of the lesion. Based on the extracted features, CAD systems can classify selected regions according to the probability of being pathological or according to specific diseases. It is important to emphasize that the CAD system primarily helps in identifying various pathological conditions of the lungs, pleura, mediastinum, heart, and spine. The CAD system focuses on detecting abnormalities such as: reduced air permeability, emphysematous changes, nodular lesions, consolidation changes, fibrous changes, mass changes, shadows of the lateral f.c. sinuses, X-ray signs of pneumothorax, hilar prominence, mediastinal width, cardiomegaly in heart disease, raised peritoneal membranes, X-ray signs of pneumoperitoneum, detection of X-ray signs of scoliosis. On X-rays, pathological conditions are presented as shadows and increased translucency, and due to the two-dimensional nature of the image, different phenomena often overlap. In addition, there is significant variability between patients. The simultaneous presence of different pathological conditions is common, all of which makes diagnosis and classification of conditions challenging. Today, numerous models are being developed and tested to assist physicians in diagnosis and provide them with a certain level of certainty. More specifically, these deep learning models should not be seen only as a method that would bring a final diagnosis, but can provide significant assistance in diagnosis, for example, by marking a place on the image that could be pneumonia, and then physicians could focus on that part and be more confident that they did not miss something (23).

Pneumonia, as one of the most common pathological conditions of the chest and a frequent reason for chest X-ray, is one of the reasons for the development of CAD models. They typically present as opacities on X-rays, and similar opacities can be

produced by a number of other conditions, such as lung cancer and excess fluid (24), and therefore diagnosis can sometimes be a major problem. Pneumonias are classified into four types based on their radiological appearance: lobar, lobular, bronchopneumonia, and interstitial pneumonia. They often coexist with other pathological conditions and show significant variability between patients. Also, the radiological appearance of pneumonia usually lags behind the clinical appearance by several days, which further delays diagnosis (25), and late diagnosis delays the initiation of effective treatment. Given the difficulties and uncertainties in diagnosis, there are also large differences in the diagnoses of different radiologists (26-28). The introduction of an automated diagnostic model would eliminate such variability and enable a certain level of standardization. CAD models in use predict whether or not pneumonia is present on an X-ray. Those images that have annotated pneumonia as present (from one of the databases) are marked as positive, and all others as negative. In addition to predicting whether there is pneumonia in the video, the model also indicates which parts of the video are suspicious for pneumonia, i.e. from which parts of the recording came the most information for predicting that pneumonia is present (29). CAD seems to focus most of its attention on recognizing pathological conditions of the lung parenchyma, while in mediastinal diseases it recognizes only cardiomegaly.

The goal of CAD model detection would naturally be to recognize all conditions that can be recognized on chest x-rays. There are several models that aim for this goal. One of them is Wang et al. (30) which proved to be efficient in the detection of cardiomegaly and pneumothorax, and worse in the detection of smaller objects, such as, for example, would belong to the labels "mass" and "nodule". Rajpurkar et al. the model for recognizing pneumonia goes even further, so that model is adapted to recognize other pathological conditions as well. The model was effective in recognizing pneumonia, fibrosis and edema (28). Irvin et al. (17) compared the performance of the model and three radiologists. The model performed best in predicting pleural effusion and worst in predicting atelectasis. Compared to individual radiologists, the model performed better in detecting cardiomegaly, edema, and pleural effusion, but not better than the majority vote of the three radiologists. Yuan et al. (30) used the AUC maximization method (DAM – Deep AUC Maximization) to build their model and won the Stanford competition for the best model for predicting five conditions (cardiomegaly, edema, consolidation, atelectasis, pleural effusion).

## CONCLUSION

CAD systems represents a significant advance in the field of medical radiology, especially in the analysis of chest radiographs. This technology uses artificial intelligence (AI) and machine learning algorithms to help radiologists recognize and analyze pathological changes in images. CAD system focuses on specific changes in the lung parenchyma, such as emphysematous changes, nodular lesions and consolidations, and on the analysis of the condition of the mediastinum and pleura. Although CAD systems can significantly improve diagnostic results, there is a limitation in its ability to completely replace the human intuition and experience of radiologists. Clinical practice

still requires human judgment. In the future, further development of CAD systems technology and integration of more advanced algorithms are expected to further improve the accuracy and efficiency of diagnostic procedures.

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# RAČUNALNO POTPOMOGNUTA DIJAGNOSTIKA I DETEKCIJA U RADIOGRAFIJI PRSNOG KOŠA

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## SAŽETAK

Umjetna inteligencija (AI) je računalna znanost koja se bavi sposobnošću računala i robota da obavljaju zadatke koji zahtijevaju neki oblik inteligencije, kao što su učenje, planiranje, prepoznavanje predmeta, razumijevanje stranih jezika itd. Primjenjuje se u raznim područjima kao što su medicina, znanost, financije, zabava, sigurnost.

Umjetna inteligencija se polako, ali sigurno integrira u zdravstveni sustav, gdje ima za cilj poboljšati ishode pacijenata, smanjiti troškove i povećati učinkovitost. Posebnu ulogu ima u području radiologije, gdje bi trebala povećati dijagnostičku i terapijsku točnost.

Različite vrste umjetne inteligencije koje su našle primjenu u radiologiji su strojno učenje, duboko učenje i neuronske mreže. Podaci o radiološkom snimanju brzo rastu i povećavaju potrebu za brojem dostupnih obučenih radiologa. Umjetna inteligencija olakšava posao radiologu skraćujući vrijeme potrebno za dijagnozu, ali služi i kao podrška za dijagnozu i tumačenje nalaza. Sustavi umjetne inteligencije igraju posebnu ulogu u radiografiji prsnog koša. Radiografija prsnog koša koristi računalni program za prepoznavanje uzoraka koji otkriva sumnjive značajke na slici i skreće pozornost radiologa kako bi se smanjila lažno negativna očitanja. Računalno potpomognuta dijagnoza ili CAD naziv je spomenutog računalnog programa. CAD sustavi, poznati kao računalno potpomognuta detekcija (CADe) i računalno potpomognuta dijagnostika (CADx), temelje se na principu dubokog učenja, odnosno konvolucijske neuronske mreže (CNN). Cilj ovog rada je ukazati na ulogu CAD sustava u točnosti i ubrzanju dijagnostičkog odlučivanja radiologa u radiografiji torakalnih organa.

**Ključne riječi**: Računalno potpomognuta dijagnostika, radiologija, detekcija, radiografija prsnog koša

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# NON-INVASIVE VENTILATION OF PATIENTS WITH COVID-19 PNEUMONIA

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## ABSTRACT

Introduction: In difficult clinical scenarios, non-invasive ventilation has become a ubiquitous therapeutic option, providing vital respiratory support without the need for invasive endotracheal intubation. It is necessary to emphasize the importance of researching the use of non-invasive ventilation in the context of coronavirus disease 2019 (COVID-19) pneumonia, analyzing its role, effectiveness, and clinical outcomes. The method of non-invasive ventilation began to be used in intensive care units, and its peak of use was in wards during the COVID-19 pandemic.

Objective: To present the results of the success of the use of non-invasive ventilation in patients in whom the use of this type of ventilation was required in comparison with the use of oxygen and high-flow oxygen.

Subjects and methods: A retrospective study was conducted in the period between January 2021 and January 2023. 17 patients treated in the COVID ward of KBC Zagreb were included. The collected data is anonymous for research purposes, which means that all data is protected and processed in the BIS (hospital information system) system.

Results: The type of ventilation affected the outcome of treatment, as shown in the following results: patients who received oxygen completed their treatment successfully (75%), while one patient died. Of the 9 patients who received high-flow oxygen therapy, only 4 (44%) survived, and of the 4 patients who received non-invasive ventilation (NIV), one died.

Conclusion: The use of NIV in the treatment of patients with COVID-19 pneumonia has been shown to be effective. This study showed that patients with comorbidities (hematological disease) very rarely or never died.

**Keywords:** non-invasive ventilation, COVID-19 pneumonia

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## INTRODUCTION

According to the definition of the World Health Organization, the coronavirus disease 2019 (COVID-19) is defined as: "Viral disease (COVID-19) which is an infectious disease caused by the SARS-CoV-2 virus" (1). Over time, non-invasive ventilation has become a key therapeutic option in the treatment of most patients with COVID-19 pneumonia, and it enables ventilatory support without the need for invasive endotracheal intubation. One of the key complications that has emerged as a challenge in the treatment of patients suffering from COVID-19 is acute respiratory insufficiency. Non-invasive ventilation became a better solution, enabling ventilatory support through masks and nasal catheters, thus reducing the need for invasive treatment methods. Ventilator placement, i.e. applied oxygenation, selection of appropriate patients and proper monitoring of ventilation parameters are key to successful treatment. Patients with severe pneumonia can develop various complications such as acute respiratory distress syndrome (ARDS), respiratory failure, septic shock and multiorgan dysfunction. It is important to emphasize that early diagnosis, monitoring, and appropriate treatment can improve the clinical outcome in these patients. Noninvasive ventilation (NIV) is ventilator support provided to patients without the use of an endotracheal tube (2). Instead of inserting an endotracheal tube into the airway, NIV is delivered through various interfaces.

This type of ventilation allows patients to breathe independently, but at the same time provides additional support in maintaining adequate ventilation and oxygenation. It is often used in the treatment of acute respiratory failure of various causes, including pulmonary edema, COVID-19 pneumonia, chronic obstructive pulmonary disease (COPD), and neuromuscular disorders. The advantages of such ventilation include fewer complications, shorter intensive care unit stays, increased quality of life, better survival, and reduced risk of potential infections (3). The main goal of NIV is to lower the partial pressure of carbon dioxide in arterial blood (PaCO2) to achieve normocapnia (4-7). The need for mechanical ventilation should be considered whenever spontaneous breathing cannot achieve adequate minute ventilation necessary to maintain Pa02 and PaCO2 and acid-base balance.

The aim of the research was to present the results of the success of the application of non-invasive ventilation in patients in whom the application of this type of ventilation was necessary in relation to the application of oxygen and high-flow nasal cannula therapy (High-Flow Nasal Cannula - HFNC).

## SUBJECTS AND METHODS

A retrospective analysis was conducted in the period between January 2021 and January 2023. Patients who were hospitalized in the COVID Department of the KBC (Clinical Hospital Center) Zagreb and who received a certain type of non-invasive ventilation during hospitalization were included.

The exclusion criterion for subjects was that the therapy did not require oxygen therapy, high-flow therapy via nasal cannula, and non-invasive ventilation.

The collected data are anonymous for the purposes of the research, which means that all data are protected and processed in the BIS (hospital information system) system,

and access to the system requires the use of a unique and personal username and password. Each finding and the patient's medical history were regularly updated in the system under the insured person's identification number.

## Statistical analysis

The data were processed in the Microsoft Office Professional Plus 2021 program. Descriptive statistics methods were used. The data are presented in absolute and relative numbers.

## Ethical statement

The use of data for research purposes was approved by the Ethics Committee of the Zagreb Clinical Hospital, under the number (02/013 AG). All data are relevant and were obtained from the BIS, in available medical histories, and were used exclusively for research purposes.

# RESULTS

This study included 17 patients with a mean age of 72 years, of whom 10 were male and 7 were female. The remaining demographic data obtained in this study are presented in the table (Table 1).

**Table 1.** *Patient demographics*

| | |
|---|---|
| Age | 51-99 |
| Gender | Male – 10 (59%)<br>Female – 7 (41%) |
| Fatal outcome of treatment | 8 (47,05%) |
| Continuation of treatment in the intensive care unit | 5 (29,41%) |
| Discharge home after hospitalization | 4 (23,52%) |
| Number of patients with hematological disease | 4 (23,52%) |
| Number of patients with respiratory failure | 3 (17%) |
| Number of patients with pneumonia | 12 (70,59%) |
| Total patients | 17 |

In female patients, only O2 was administered more often, and in male patients, HFNC and NIV (Figure 1).

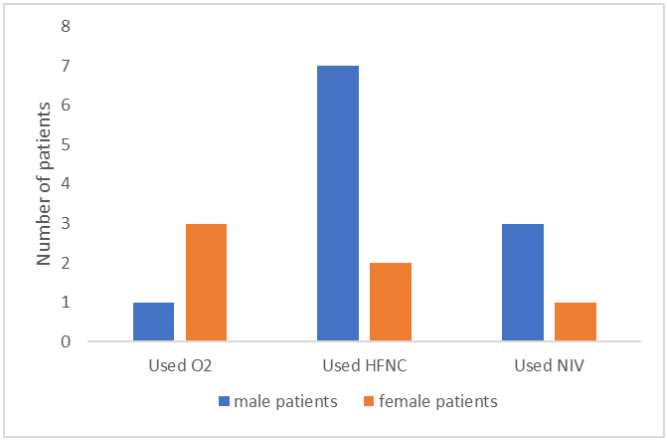


**Figure 1.** *Gender and ventilation used*

In older patients, mortality was more frequent than in other younger patients (Figure 2).

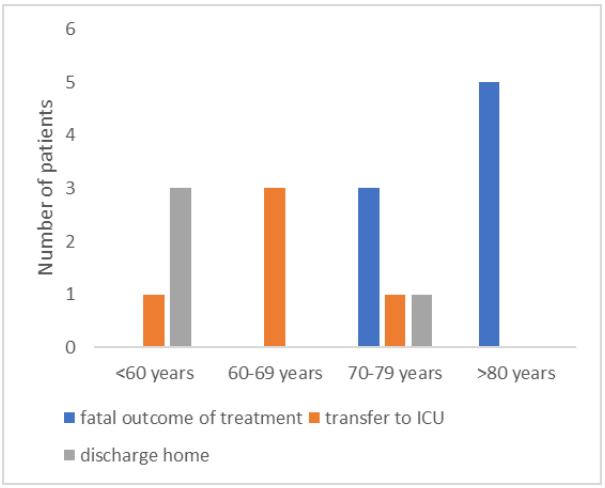


**Figure 2.** *Treatment outcome in relation to patient age*

HFNC therapy was most commonly used, while NIV and O2 were equally frequently used (Figure 3).

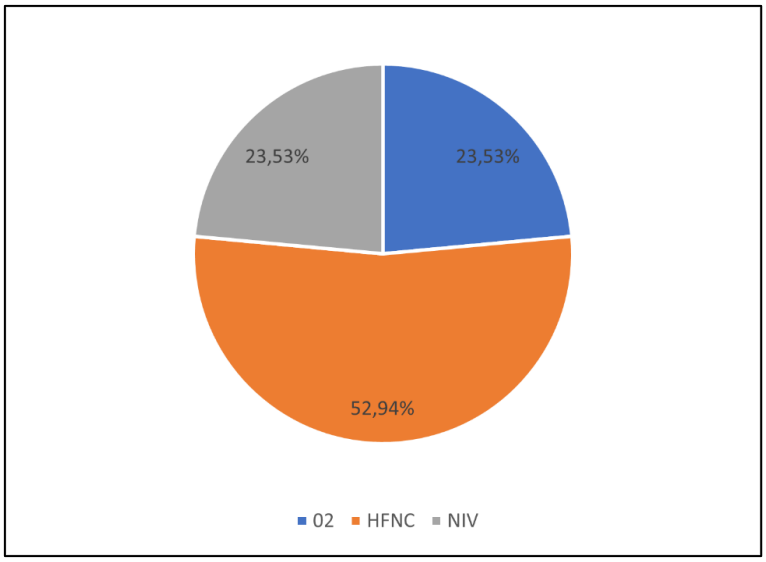


**Figure 3.** *Type of ventilation applied*

In the conducted study, the highest percentage of patients ended in death (Figure 4).

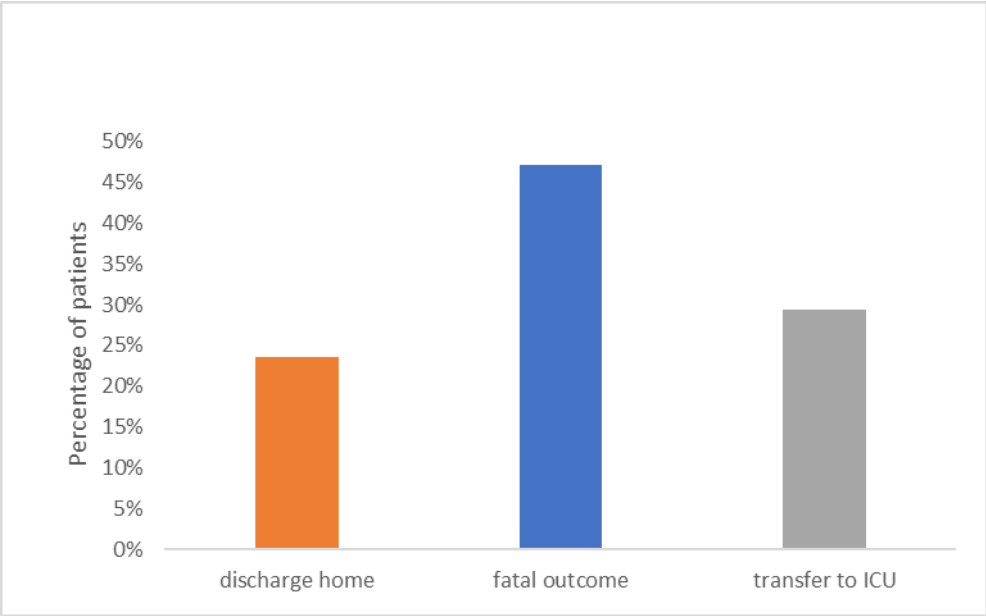


**Figure 4.** *Comparison of data for patients discharged home, transferred to the Intensive Care Unit (ICU), and those with a fatal outcome*

The data obtained from the study showed that 4 patients were recorded as suffering from hematological diseases, while the remaining 13 did not have any type of comorbidity. It was also shown that patients suffering from hematological diseases (23.52%) did not have a fatal outcome, but those patients who developed pneumonia (41.17%) and respiratory failure (5.88%) were significantly fewer (Figure 5).

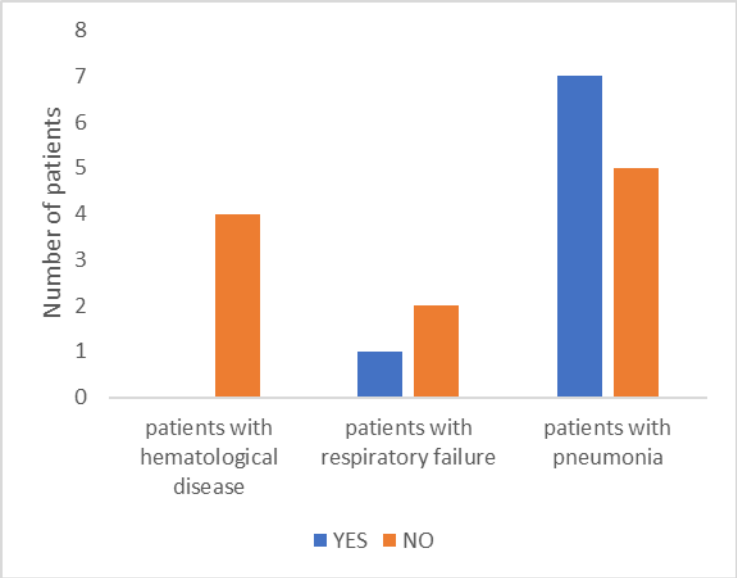


**Figure 5.** *Mortality due to hematological disease, respiratory failure, and pneumonia*

The type of ventilation affected the outcome of treatment, as shown in the following results: patients who received 02 completed their treatment successfully (75%), while one patient died. Of the 9 patients who received HFNC therapy, only 4 (44%) survived, and of the 4 patients

who received NIV, 3 (75%) survived (Figure 6).

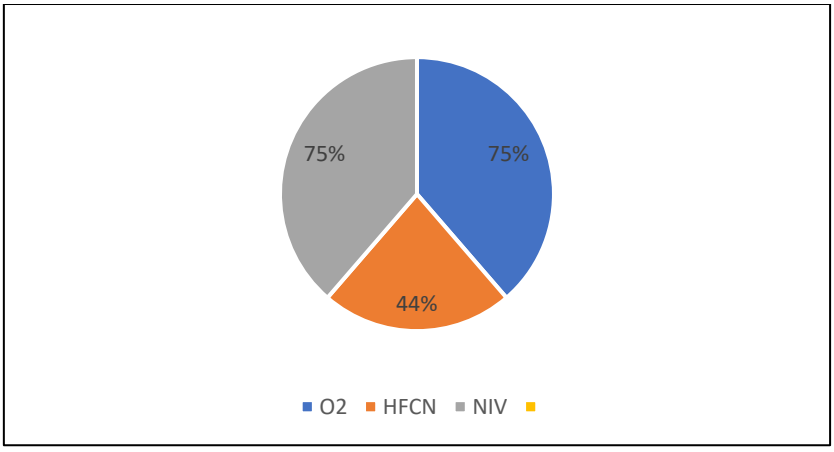


**Figure 6.** *Treatment outcome according to type of ventilation*

## DISCUSSION

The use of noninvasive ventilation in the treatment of COVID-19 pneumonia has significantly impacted patient outcomes during the pandemic. One of the key advantages of NIV is the ability to preserve spontaneous breathing, which helps maintain lung function and reduce disease progression. A study from China by Wang et al. showed a mortality rate of 97% among intubated patients; the median duration of ventilation was 4 days (8). In another study also from China by Meng et al. from China, only 3.2% of a total of 80,409 patients with COVID-19 of all severity were actually intubated (9). A study in Italy by Grasselli et al. on 1591 patients showed that 88% of patients were intubated, while the mortality rate among those who completed intensive care was 64% (10). A study by Srinivasaiah et al. showed that mortality among those intubated within 24 hours of admission was higher compared to those on NIV (11). Ultimately, intubation with invasive ventilation must always be considered as one component of the overall treatment plan. On the one hand, it is often the only way to ensure that the patient receives sufficient oxygen. However, in older individuals with comorbidities and other organ dysfunctions, especially in the case of prolonged ventilation as is the case with COVID-19, complications must be anticipated.

This study presents the results of the effectiveness of non-invasive ventilation in patients with COVID-19 pneumonia and chronic diseases, and the final treatment outcomes are presented. This study included 17 patients, of whom 10 were male (59%) and 7 were female (41%), while in the study conducted by Krivačić, 85 (69.11%) men and 38 (30.89%) women participated (12). The age of the patients in the study ranged from 51 to 99 years, and the average age was 72 years, and in the study conducted by Krivačić in the Karlovac General Hospital it was 65.95 years (12). In the study conducted by Srinivasaiah et al., the age of the patients ranged from 34 to 72 years (11).

This study confirmed that more than half of the patients (53%) received HFNC therapy, while the study by Krivačić conducted in the Karlovac General Hospital showed that for the same

application, 54.27% of patients were treated with NIV, 4 (24%), of whom 3 were male and only 1 female, while in the Jarić study, out of 174 subjects, 102 were documented to have received NIV therapy (12, 13). Krivačić's study confirms the fact, as in this study, that younger age was a key parameter for the success of the therapy (12). Krivačić's study states that in the group in which only HFNC therapy was used, the proportion of male patients is higher, which can also be confirmed by this study (12). In this study, a third of male patients were treated with NIV (30%), while female patients were mainly treated with 02. I state that the average number of days of hospitalization is 24 regardless of the data (age, gender, use of ventilation, etc.), while in the study by Krivačić, patients who received HFNC therapy had an average number of days (6.82) longer than the group of patients (2.70) who received invasive mechanical ventilation due to disease progression (12). The results of the study by Bonnet et al. show that the average number of days was 11 in patients on HFNC (14). Mortality in the study conducted by Krivačić was 79.78% of 123 subjects, in patients who received non-invasive ventilation and/or invasive mechanical ventilation, which leads to the conclusion that invasive mechanical ventilation is associated with a high mortality rate (12). The study by Schönhofer et al. and Warren et al. state that two key factors for successful treatment with non-invasive ventilation are the rotation of the mask type and the selection of the appropriate interface. Their tests proved that changing different types of masks improves the effectiveness of treatment in the treatment of acute respiratory failure (15, 16). Through a comprehensive review of the current state of knowledge and practice, this paper provides a foundation for further research and improvement of the application of non-invasive ventilation in the treatment of Covid-19 patients. The results indicate that proper use of noninvasive ventilation can reduce the need for invasive ventilation and improve clinical outcomes.

Despite all the challenges in treating patients with COVID-19 pneumonia, non-invasive ventilation remains an important choice in the treatment of such patients, which certainly confirms its role in modern and intensive care medicine. Further research is needed to optimize its application.

## CONCLUSION

The use of NIV in the treatment of patients with Covid-19 pneumonia has been shown to be effective. This study showed that patients with comorbidities (hematological disease) very rarely or never ended in death.

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# NEINVAZIVNA VENTILACIJA PACIJENATA SA COVID-19 PNEUMONIJOM

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## SAŽETAK

Uvod: U teškim kliničkim scenarijima, neinvazivna ventilacija postala je sveprisutna terapijska mogućnost, pružajući vitalnu podršku pri disanju bez potrebe za invazivnom endotrahealnom intubacijom. Potrebno je istaknuti važnost istraživanja primjene neinvazivne ventilacije u kontekstu koronavirusne bolesti 2019 (COVID-19) pneumonije, analizirajući njezinu ulogu, učinkovitost i kliničke ishode. Metoda neinvazivne ventilacije sa korištenjem je krenula u jedinicama intenzivne medicine, a svoj vrhunac primjene doživjela je na odjelima u periodu COVID-19 pandemije.

Cilj: Prezentirati rezultate uspješnosti primjene neinvazivne ventilacije kod pacijenata kod kojih je primjena takve vrste ventilacije bila potrebna u odnosu na primjene kisika i visokog protoka kisika.

Materijali i metode: Provedena je retrospektivna studija u vremenskom razdoblju između siječnja 2021. do siječnja 2023. godine. Uključeno je 17 pacijenata liječenih na COVID odjelu KBC-a Zagreb. Prikupljeni podatci su za potrebe istraživanja anonimni, što znači da su svi podatci zaštićeni i obrađeni u BIS (bolnički informacijski sustav) sustavu.

Rezultati: Vrsta ventilacije je utjecala na ishod liječenja što je prikazano u slijedećim rezultatima: pacijenti kod kojih je korišten kisik završilo je svoje liječenje uspješno (75%), dok je jedan pacijent preminuo. Pacijenti kod kojih je korištena terapija visokim protokom kisika, od njih sveukupno 9 samo 4 (44%) je preživjelo, a pacijenti kod kojih je korišten neinvazivna ventilacija (NIV), od njih 4, jedan je preminuo.

Zaključak: Korištenje NIV-a pri liječenju pacijenata s COVID -19 pneumonijom pokazalo se učinkovito. Ovim istraživanjem se pokazalo da pacijenti s komorbiditetima (hematološka bolest) su vrlo rijetko ili uopće nisu završili smrtnim ishodom.

**Ključne riječi:** neinvazivna ventilacija, COVID-19 pneumonija

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# BENIGN FASCICULATION SYNDROME

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## ABSTRACT

Fasciculations are uncontrolled and uncoordinated muscle twitches that most commonly occur in healthy individuals but can cause concern and anxiety. In this paper, we analyze benign fasciculation syndrome (BFS), which is diagnosed after excluding other pathological causes. Although the prevalence of benign fasciculations is considered high, the symptoms of BFS persist and may last for years without serious consequences. The focus on the relationship between BFS and anxiety is also important, as anxiety can exacerbate feelings of discomfort and lead to health anxiety or hypochondria. There is a significant fear of motor neuron diseases, such as amyotrophic lateral sclerosis (ALS), which further complicates the clinical picture for patients. Long-term monitoring shows that most patients with BFS do not develop ALS, but recommendations for further monitoring and support remain crucial. This paper suggests that, despite the benign nature of fasciculations, patients should consult a neurologist to exclude more serious conditions, and in cases of significant anxiety, consider medical or psychosocial assistance. The results indicate that patients with persistent fasciculations are on the path to better diagnosis and symptom reduction through professional help and support.

**Key words:** benign, fasciculation, syndrome
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## INTRODUCTION

### Fasciculations

Fasciculations are uncontrolled and uncoordinated muscle twitches that can manifest as simultaneous contractions of entire bundles or fascicles of muscle fibers (1). Many healthy individuals occasionally experience fasciculations, particularly in the calf and arm muscles as well as around the eyes and nose. They can last almost continuously for days or weeks, and even years in some individuals, without causing weakness or muscle wasting (2). It is believed that constant benign fasciculations are common in the population, affecting more than 1% of individuals (3), while over 70% of the healthy population experiences them at some stage in their lives (4).

Benign fasciculations represent a type of fasciculations wherein all other potential pathological causes have been excluded, leading to a diagnosis known as Benign Fasciculation Syndrome (BFS). The diagnosis typically requires a standard neurological examination and electromyography (EMG) (5).

In addition to benign fasciculations, they can be part of neurological injuries such as radiculopathies (6), autoimmune diseases (7), peripheral nerve hyperexcitability syndromes (8), or fasciculations may be the first symptom of motor neuron disease, i.e., a progressive neurodegenerative disorder (9).

The etiology of benign muscle fasciculations is still unknown, but is associated with stress, anxiety, caffeine, electrolyte imbalances, smoking, and excessive exercise. Although sometimes an initial cause, such as anxiety, may fade, fasciculations as a symptom often continue to persist (10).

## BENIGN FASCICULATION SYNDROME AND ANXIETY

The relationship between anxiety and benign fasciculation syndrome (BFS) is frequently discussed and is quite complex. It is believed that the association is bidirectional, with anxiety potentially triggering or exacerbating fasciculations, while fasciculations can provoke or amplify anxiety, even leading to hypochondria. The benign fasciculation syndrome can create such anxiety in individuals that it is recommended for neurologists to pay particular attention to the anxiety levels of patients with BFS; if reassuring advice does not help, they should not hesitate to refer the patient for psychiatric help (11). In some cases, anxiety can be so severe that it meets the criteria for a condition known as Health anxiety disorder. This psychiatric disorder is characterized by a persistent preoccupation with the fear of having a serious physical illness, leading to significant emotional distress despite negative findings and reassurances, a condition synonymous with hypochondria (12).

Undoubtedly, the greatest concern for patients regarding muscle fasciculations is the association with motor neuron disease known as Amyotrophic Lateral Sclerosis (ALS), famously named after the baseball player Lou Gehrig, who was diagnosed with this disease in 1939 (13). Research has shown that patients with benign fasciculation syndrome (BFS) have similar levels of depressive and anxiety symptoms compared to patients who actually have motor neuron disease. It is also interesting to note that patients with BFS exhibit a higher frequency of psychosomatic symptoms, stress, and a higher rate of previous psychiatric disorders, which has

led some researchers to speculate that BFS could be a form of somatization disorder (14). It is noteworthy that this condition is quite common among professionals in the medical field (15).

BFS leads to such high levels of anxiety because patients fall into a vicious cycle of self-observation and excessive unnecessary analysis of internal bodily sensations, which aims to achieve immediate relief from anxiety, although this ultimately leads to increased anxiety. Searching online forums about BFS, constant self-testing of muscle strength, and inspecting for potential muscle deficits are just some of the behaviors that burden patients under the assumption that they may suffer from motor neuron disease. Insomnia, muscle spasms, swallowing problems, and tingling are symptoms that patients somatize, believing they have ALS (11).

## AMYOTROPHIC LATERAL SCLEROSIS VS. BENIGN FASCICULATION SYNDROME

Amiotrophic lateral sclerosis (ALS) is a progressive neuromuscular disease with a fatal outcome, characterized by the degeneration of motor neurons, both upper and lower, resulting in dysfunction of somatic muscles in the body. ALS is the most common form of motor neuron disease, with an average incidence of 2.8 per 100,000 in Europe and an average prevalence of 5.40 per 100,000 in Europe (Chio et al. 2013). Men are slightly more affected than women, and the median survival after the onset of the disease is typically 2 to 4 years and does not depend on sex (16). The clinical picture of ALS usually consists of focal muscle weakness and atrophy that spreads with disease progression. Weakness most often appears in the limb muscles, more frequently in distal muscles than in proximal muscles. In approximately 25-30% of cases, the disease begins bulbarly, presenting with dysarthria, dysphagia, dysphonia, or, less frequently, weakness of the masseter muscles used for chewing (17).

When symptoms of BFS occur without weakness or atrophy, and the electromyography (EMG) is normal, it has been considered that the diagnosis of ALS is excluded. This statement is supported by a follow-up study of 121 patients diagnosed with benign fasciculation syndrome, none of whom developed ALS during a follow-up period of 2 to 32 years (18).

However, more recent findings have emerged. Research conducted at the neurology and neurosurgery center in Liverpool published a paper on four cases of individuals who had benign fasciculation syndrome and cramps, who later developed ALS over time. Therefore, it is recommended that patients be monitored for 4-5 years before making a final decision that fasciculations and cramps are of a benign nature (19). There is a clinical condition related to BFS, which is further characterized by increased muscle cramping and is called the Syndrome of Cramps and Fasciculations (20).

The potential connection of fasciculations with one of the worst neurological diseases often leads patients to experience health anxiety or hypochondria, resulting in various somatizations. This is significantly contributed to by cyberchondria, specifically the attempt to find solutions online, even when the symptoms are not severe, which leads to a spiraling effect and a vicious cycle from which patients cannot escape (21). Although BFS is of a benign nature, it does not completely

resolve over time, although in half of the cases, there is a tendency for some improvement (22). Some studies show that cognitive-behavioral therapy provides excellent results in treating health anxieties (23,24).

## CONCLUSION

The benign fasciculation syndrome represents a chronic, non-progressive condition characterized by fasciculations, or involuntary and uncontrolled muscle twitches, most commonly in the lower extremities, and is not associated with other clinical or neurophysiological abnormalities. Long-term monitoring of these cases has confirmed the benign nature of the disease.

Although there is significant concern among patients regarding the occurrence of fasciculations, they are generally benign in nature and are classified as benign fasciculation syndrome. Excessive analysis and self-observation of various bodily sensations tend to further exacerbate anxiety and generally delay the escape from the vortex in which they find themselves.

Seeking professional help as soon as possible, with the aim of eliminating more serious pathology and establishing a favorable diagnosis of BFS, can significantly reduce symptoms and calm the patient. Experts recommend performing electromyography (EMG) and, additionally, to confirm the exclusion of serious pathology, an MRI of the brain and spine is suggested.

If normal findings do not reassure the patient, further psychiatric help in the form of cognitive-behavioral therapy is recommended.

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# BENIGNI FASCIKULACIJSKI SINDROM

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## SAŽETAK

Fascikulacije su nekontrolirano i nekoordinirano trzanje mišića, koje se najčešće javljaju u zdravih osoba, ali mogu uzrokovati zabrinutost i anksioznost. U ovome radu analiziramo benigni fascikulacijski sindrom (BFS), koji se dijagnosticira nakon isključenja drugih patoloških uzroka. Iako se smatra da je prevalencija benignih fascikulacija visoka, simptomi BFS-a perzistiraju i mogu trajati godinama bez ozbiljnih posljedica. Fokus na vezi između BFS-a i anksioznosti također je važan, budući da anksioznost može pojačati osjećaj nelagode i dovesti do zdravstvene anksioznosti ili hipohondrije. Uočen je značajan strah od bolesti motoneurona, poput amiotrofične lateralne skleroze (ALS), što dodatno komplicira kliničku sliku pacijenata. Dugotrajno praćenje pokazuje da većina pacijenata s BFS-om ne razvija ALS, ali preporuke o daljnjem praćenju i podršci ostaju ključne. Ovaj rad sugerira da se, unatoč benignoj prirodi fascikulacija, pacijenti trebaju konzultirati s neurologom radi isključenja ozbiljnijih stanja, a u slučajevima značajne anksioznosti razmotriti medicinsku ili psihosocijalnu pomoć. Rezultati sugeriraju da su pacijenti s konstantnim fascikulacijama na putu ka boljoj dijagnozi i smanjenju simptoma kroz profesionalnu pomoć i podršku.

**Ključne riječi:** benigni, fascikulacijski, sindrom

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# THE EFFECTS OF PHYSICAL EXERCISE ON PAIN, MOTOR ABILITIES AND QUALITY OF LIFE IN AN ELDERLY WOMAN WITH CHRONIC PAIN: A CASE REPORT

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## ABSTRACT

Introduction: Physical activity has the potential to improve the physical and mental health of older adults, reducing the risk of joint pain and disability. Previous research suggests that regular muscle-strengthening exercise can enhance quality of life, however, chronic pain remains a challenge that negatively affects daily activities and social participation. Due to the importance of maintaining physical fitness in older age, tailored physical activity programs are recommended.

Objective: Assess the impact of six physical activity treatments on pain, motor abilities, and quality of life in an elderly woman with chronic hip and knee joint pain.

Case Report: The participant, a 74-year-old elderly woman, reported chronic hip and knee pain. Physical assessment included the Senior Fitness Test, Barthel Index, NRS pain scale, vital signs, and body composition analysis. After four weeks of therapy encompassing strength, stretching, and endurance exercises, no significant improvement in mobility was observed, but vital signs remained stable. The intensity of joint pain did not decrease.

Conclusion: The results indicate that physical activity can have selective effects on various aspects of health in older adults, but combination with other therapies is necessary for more significant outcomes. Further research with larger samples and longer treatment durations is needed to better understand the effects of physical activity.

**Keywords:** Senior Fitness Test, physiotherapy, physical exercise, quality of life

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## INTRODUCTION

Current physical activity guidelines recommend muscle-strengthening activities for health promotion among all adults, including older adults (1, 2). Scientific evidence increasingly suggests that exercise can enhance the developmental, physical, mental, and social dimensions of well-being in older adults (3). Research suggests that older adults who regularly engage in muscle-strengthening exercises have a better quality of life, particularly in their general health perception. However, muscle-strengthening activities might be associated with knee pain. Although most previous studies on the impact of muscle-strengthening activities were conducted under supervision, the majority of older adults exercise without supervision, which may increase the risk of injury (4). Persistent, recurrent chronic pain affects 39-70% of older adults worldwide (5-8) and negatively impacts their daily lives, not only by causing discomfort but also by limiting their activities, contributing to loneliness and social isolation (9). Hip, knee, and ankle pain are major causes of pain and disability locally and represent the second most significant global factor contributing to long-term disability (10). Knee pain is the second most commonly reported painful region in the human body, second only to the back, with an overall prevalence of 46.2% (11). Although the prevalence, impact, and future burden of back, knee, and hip pain are well-documented, data on foot pain were limited until relatively recently. It is now known that foot pain is highly prevalent among older adults in the general population and is more common in women (12-15). A study in North Yorkshire analyzed lower limb problems in 16,000 individuals aged 55 and over. The research findings highlight the importance of self-assessment of pain and functional activities in daily life, particularly concerning the foot and ankle. The most common combinations of foot pain with other joints were: foot and knee; foot, knee, and hand; foot, knee, and hip; and foot and hand (16). Recurrent ankle injuries, mainly sprains, are one of the most commonly treated injuries. For example, in the UK alone, 5,000 such injuries are treated every day, mainly by general practitioners (17). For sedentary individuals, such injuries can be painful but usually do not cause significant impairment. Health-related well-being, often referred to as "quality of life," is important for patients with joint pain as it can affect their routine daily activities (18). Although it is widely recognized that pain and physical impairments associated with musculoskeletal conditions negatively affect function, mental health, and quality of life (19). The assessment of physical fitness is important both in research and in practice. One of the standard methods for adults aged 60 and over is the Senior Fitness Test (SFT), introduced by Rikli & Jones in 1999 (20). Not only is it used extensively in healthy individuals, but it has also proven feasible in populations with reduced mobility resulting from various neurological conditions (21). Pain in older adults can negatively impact quality of life in many ways. It can severely hinder daily functioning, is associated with depression, and older people consider it one of the greatest health burdens. This holds true for older adults living in the community as well as for those living in healthcare facilities (22).

The aim of this study was to assess the impact of six physical activity treatments on pain, motor abilities, and quality of life in an elderly woman with chronic hip and knee joint pain.

## METHODS

### Subject and Procedures

The participant in this study was a 74-year-old female with chronic hip and knee joint pain. The following instruments and assessments were used for data collection: the one-dimensional Numerical Rating Scale (NRS) (23), the Senior Fitness Test (20), assessment of vital signs (24), body composition assessment using a Tanita device based on bioelectrical impedance analysis (BIA) (25), and the Modified Barthel Index questionnaire (26). Measurement of morphological characteristics included body height and body weight. Descriptive statistics methods were used for the analysis of the collected data. Initial and final values are presented for each measured variable (e.g., leg strength, arm strength, endurance test, flexibility, body composition, quality of life, pain intensity, vital signs). Absolute changes (difference between final and initial values) and relative changes (expressed as percentages) were calculated to quantify the effect of the therapeutic intervention. The results are presented in tabular and graphical form for clarity and easier observation of individual changes in the participant. The NRS scale is the most commonly used one-dimensional scale. On a scale from 0 to 10, the patient numerically rates the intensity of pain. A rating of zero (0) indicates no pain, 1 to 3 indicates mild pain, 4 to 6 moderate pain, while scores from 7 to 10 indicate very severe pain. The advantage of this scale lies in its simplicity, frequency of use, and validation across numerous pain settings. Disadvantages include its inapplicability to young children and older adults with hearing, visual, or cognitive impairments (6). The Senior Fitness Test is a protocol developed by Rikli and Jones, designed to assess the functional fitness level of individuals over 60 years of age. Bioelectrical impedance analysis (BIA) is a rapid, non-invasive, and relatively inexpensive method for evaluating body composition in field and clinical settings. Pioneering work in the early 1960s laid the foundation for modern BIA. The BIA method assesses body composition by emitting a low and safe electrical current through the human body. The current passes through muscles with low resistance, while higher resistance is encountered when passing through adipose tissue. Advanced technology and traditional BIA are combined in the TANITA DC-430MA scale. Modern body fat monitors provide accuracy comparable to reference standards in measuring body fat percentage. Vital signs, including blood pressure and heart rate, were measured using a BEURER BM 44 digital upper arm blood pressure monitor. This device provides precise blood pressure values in mmHg, including systolic and diastolic pressure, and heart rate in beats per minute (bpm). Capillary pulse oximetry (SpO2 - Saturation of peripheral Oxygen) is a routine non-invasive spectrophotometric method allowing continuous measurement of peripheral oxygen saturation. The measured value is denoted as SpO2. The device is most often placed on the fingertip (27). For the purposes of this research, measurements were taken using the BEURER PO 80 device. The Modified

Barthel Index questionnaire provides an assessment of the participant's ability to perform activities of daily living and evaluates their quality of life. For assessing quality of life, the Modified Barthel Index of activities of daily living was used, comprising a total of 30 variables. For assessing motor abilities, motor tests comprising a total of 8 variables were used. For assessing pain intensity, the NRS pain scale was used, comprising a total of 3 variables. For assessing vital signs, 3 variables were used, and for assessing body composition, the Tanita device, based on bioelectrical impedance analysis (BIA), was used, providing a total of 14 variables. A total of 59 variables were used in the study.

## Case Report

This case study presents the results of a female patient experiencing extremely severe pain in her right hip and knee joint. The pain first appeared 10 years ago and primarily occurred during walking. Recently, she has experienced severe pain along with a lack of strength in her legs. The participant is 74 years old, with a body height of 158 cm and a body weight of 76.90 kg. The participant has been retired for twelve years. The physiotherapy assessment consisted of taking a medical history, assessing hip joint pain using the Numerical Rating Scale (NRS) for pain intensity, and administering the Senior Fitness Test. The Senior Fitness Test included assessments of leg strength, arm strength, shoulder girdle mobility, posterior thigh flexibility, endurance, and agility, adapted according to the patient's hip joint pain. Initial testing was performed before the start of the physiotherapy treatment, and final testing was conducted after the treatment.

## Intervention

The applied physiotherapy treatment consisted of a physical exercise program, comprising six physical exercise sessions over four weeks. On the NRS scale at initial testing, the pain intensity in the right hip was rated 10, and pain in the right knee was rated 7, which represents extremely high values. Ankle pain was rated 1. Initial Senior Fitness Test results were: leg strength 19 repetitions, arm strength 14 repetitions, endurance test 70 repetitions, right shoulder flexibility -9 cm, left shoulder flexibility -14 cm, right hip flexibility -13 cm, left hip flexibility -14 cm, and agility test 6.68 seconds. Data from the initial Barthel Index assessment indicate that the participant demonstrated relatively good independence in daily activities. The overall score is solid, although the results suggest an average energy level and acceptance of body image, while negative emotional feelings occur more frequently. Initial vital signs results before physical exercise show stable vital signs for the participant, with values of pulse 70 beats per minute, SpO2 96%, and blood pressure (SYS/DIA) 149/83 mmHg. Initial body composition values were: Body Weight - 76.90 kg, Fat % - 41.60%, Fat Mass - 32.00 kg, FFM (Fat-Free Mass) - 44.90 kg, Muscle Mass - 42.60 kg, TBW (Total Body Water) - 30.80 kg, TBW % - 40.10%, Bone Mass - 2.30 kg, BMR (Basal Metabolic Rate) - 1365.0 kcal, Visceral Fat Rating - 12.0 [units specified as kg in original], BMI (Body Mass Index) - 30.80 kg/m², and Ideal Body Weight - 54.90 kg. Over 4 weeks, an exercise program based on the

SFT was implemented, which included: stretching exercises, chair stand exercises, arm curl exercises, the 2-minute step test, and agility exercises.

## Objectives

The primary aim of the therapy was to reduce pain intensity, while the secondary aims were to improve the participant's motor abilities and enhance quality of life.

## RESULTS

After four weeks and the completion of 6 physical exercise sessions, final testing was conducted. On the NRS scale, the participant rated the pain intensity in the right hip as 10 and in the right knee as 7, representing extremely high values. The pain values after the treatment remained the same as at the initial testing. Final Senior Fitness Test results were: leg strength 21 repetitions, arm strength 14 repetitions, endurance test 77 repetitions, right shoulder flexibility -8 cm, left shoulder flexibility -13 cm, right posterior thigh flexibility -12 cm, and agility test 6.79 seconds. Comparing the initial and final testing results, several significant improvements were noted in specific areas. Leg strength increased from 19 to 21 repetitions, while arm strength remained the same at 14 repetitions. Also, the endurance test showed improvement, increasing from 70 to 77 repetitions. The flexibility variable shows an improvement in posterior thigh range of motion by 1 cm, while the agility test score also improved by 0.11 seconds. Scores for the tested variables (extent to which pain interferes with duties, energy for daily life, acceptance of physical appearance, frequency of negative feelings like low mood, despair, anxiety, depression) remained low in both initial and final assessments using the Barthel Quality of Life questionnaire. Pain was still present but moderately interfered with performing daily activities, as did a lack of energy for daily life. Also noted were a low level of acceptance of physical appearance and the frequent occurrence of negative emotional states such as low mood, despair, anxiety, and depression (Table 1 and 2).

**Table 1.** *Results of initial and final quality of life testing.*

| Age | Bladder control | Personal hygiene | Toileting | Feeding | Transfer (e.g.,bed to chair) | Mobility | Dressing | Stair climbing | Bathing | Total score | Are you currently ill |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 74 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 18 | NO |
| 74 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 18 | NO |

**Table 2.** *Results of initial and final quality of life testing*

| How would you rate your quality of life? | How satisfied are you with your health? | To what extent does pain prevent you from doing what you need to do? | How much do you enjoy life? | To what extent do you feel your life to be meaningful? | How well are you able to concentrate? | How physically safe do you feel in your daily life? | Do you have enough energy for everyday life? | Are you able to accept your bodily appearance? | How available to you is the information you need in your day-to-day life? | Do you have opportunities for leisure activities? | How well are you able to get around? | How satisfied are you with your sleep? | How satisfied are you with your ability to perform your daily living activities? | How satisfied are you with your capacity for work? | How satisfied are you with yourself? | How often do you have negative feelings such as blue mood, despair, anxiety, depression? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4 | 3 | 4 | 5 | 5 | 4 | 3 | 3 | 4 | 5 | 4 | 4 | 5 | 5 | 5 | 2 |
| 4 | 4 | 3 | 4 | 5 | 5 | 4 | 3 | 3 | 4 | 5 | 4 | 4 | 5 | 5 | 5 | 2 |

Final testing results showed that the participant demonstrated improvement in leg strength, increasing from an initial score of 19 to a final score of 21 repetitions, indicating enhanced leg strength. In arm strength, the participant maintained the same score of 14 repetitions between initial and final testing, which is within the normal range for her age group. The endurance test showed improvement, increasing from an initial 70 to 77 repetitions, indicating improved general endurance. Right shoulder girdle flexibility improved from -9 cm to -8 cm, while left shoulder flexibility improved from -14 cm to -13 cm. Right hip flexibility improved from -13 cm to -12 cm, and left hip flexibility improved from -15 cm to -14 cm. In the agility test, the time worsened from 6.68 seconds to 6.79 seconds (Table 3).

**Table 3.** *Comparison of initial and final motor test results*

| | SNNO (Leg Strength) | SNRU (Arm Strength) | TEIZD (Endurance Test) | PRAM D (Right Shoulder Flexibility) | PRAM L (Left Shoulder Flexibility) | PKUK D (Right Hip Flexibility) | PKUK L (Left Hip Flexibility) | TESPR (Agility Test) |
|---|---|---|---|---|---|---|---|---|
| Initial testing | 19 | 14 | 70 | -9 | -14 | -13 | -15 | 6,68 |
| Final testing | 21 | 14 | 77 | -8 | -13 | -12 | -14 | 6,79 |

## Age variable and standards

The normal range of results for women is defined as the middle 50% of the population. Those with scores above this range will be considered above average for their age, and those below the range as below average (Table 4).

**Table 4.** *The normal range of results for women*

| Age | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 |
|---|---|---|---|---|---|---|---|
| SNNO (Leg Strength) | 12 to 17 | 11 to 16 | 10 to 15 | 10 to 15 | 9 to 14 | 11 to 13 | 4 to 11 |
| SNRU (Arm Strength) | 13 to19 | 12 to 18 | 12 to 17 | 11 to 17 | 10 to 16 | 10 to 15 | 8 to 13 |
| TEIZD (Endurance Test) | 75 to 107 | 73 to 107 | 68 to 101 | 68 to 100 | 60 to 91 | 55 to 85 | 44 to 72 |
| PRAM (Shoulder Flexibility) cm | -7.62 to +3.81 | -8.89 to +3.81 | -8.89 to +3.81 | -10.16 to +2.54 | -13.97 to + 0.0 | -17.78 to -2.54 | -20.32 to -2.54 |
| PKUK (Hip Flexibility) cm | -1.27 to +12.7 | -1.27 to +12.7 | -1.27 to +11.43 | -2.54 to +10.16 | -3.81 to + 8.89 | -6.35 to +6.35 | -11.43 to +2.54 |
| TESPR (Agility Test) sec | 6.0 to 4.4 | 6.4 to 4.8 | 7.1 to 4.9 | 7.4 to 5.2 | 8.7 to 5.7 | 9.6 to 6.2 | 11.5 to 7.3 |

The pain scale results show that pain levels remained unchanged between initial and final testing (Table 5). Initially, hip joint pain was rated 10, knee joint pain was 7, and ankle pain was 1. These values remained the same at the final measurement.

**Table 5.** *Initial and final NRS pain scale values*

| | Hip joint pain (1-10) | Knee joint pain (1-10) | Ankle joint pain (1-10) |
|---|---|---|---|
| Initial testing | 10 | 7 | 1 |
| Final testing | 10 | 7 | 1 |

It is evident that the vital signs (SpO2, systolic/diastolic blood pressure, and pulse) remained largely stable between the initial and final testing. Initial SpO2 was 96%, final was 96%; initial blood pressure (SYS/DIA) was 149/83 mmHg, final was 150/83 mmHg; initial pulse was 70 bpm, final was 70 bpm (Table 6).

**Table 6.** *Initial and final vital signs values*

| | SPO2 % | SIS/DIS | PULSE |
|---|---|---|---|
| Initial testing | 96 | 149/83 | 70 |
| Final testing | 96 | 150/83 | 70 |

Body composition values showed improvement from initial to final testing in the following variables: Body weight decreased from 76.90 kg initially to 76.60 kg finally, and Fat Mass decreased from 32.00 kg initially to 31.80 kg finally. Other measured body composition values remained unchanged (Table 7).

**Table 7.** *Initial and final body composition values*

| | **Height** (cm) | Age | Body Weight (kg) | FAT % | FAT MASS (kg). | FFM (Fat-Free Mass) (kg) | Muscle mass (kg). | TBW (Total Body Water) (kg) | TBW % | Bone mass (kg) | BMR (Basal Metabolic Rate) (kcal) | Visceral fat rating (kg) | **BMI (Body Mass Index)** (kg/m²) | Ideal body weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial testing | 158,00 | 74 | 76,90 | 41,60 | 32,00 | 44,90 | 42,60 | 30,80 | 40,10 | 2,30 | 1365,0 | 12,0 | 30,80 | 54,90 |
| Final testing | 158,00 | 74 | 76,60 | 41,60 | 31,80 | 44,90 | 42,60 | 30,80 | 40,10 | 2,30 | 1360,0 | 12,0 | 30,80 | 54,90 |

## DISCUSSION

This research was conducted on a single participant and utilized a total of 53 variables, including the Modified Barthel Index of quality of life, motor tests, pain scale, vital signs, and body composition parameters. The study provides insight into the complex interaction between physical activity, quality of life, motor abilities, and health. Analyzing the Barthel Quality of Life test, preserved independence in basic activities of daily living (ADLs) is observed. The participant maintained a high level of independence in performing basic ADLs such as hygiene, feeding, transfers, mobility, dressing, stair climbing, and bathing. These results remained stable between initial and final testing. She rated her satisfaction with quality of life as moderate, which may mean she feels there are aspects of life she would like to improve, but generally does not feel completely dissatisfied. Furthermore, she rated her health as good and stated that pain moderately interfered with performing daily activities.

Considering she rated her hip pain as 10 on the NRS scale, within the quality of life assessment, she rated the pain as present, but not intense enough to completely prevent her from carrying out her duties. Social support and activities include the participant's assertion that necessary information is available to her in daily life and that she has opportunities for recreation. It also indicates a moderate energy level. The participant has enough energy for most activities but may feel tired after more demanding tasks or during the day. Although the participant generally functions in daily life, there are aspects that could be improved to enhance overall quality of life. It is recommended to pay attention to mental health, pain management, and energy enhancement through appropriate activities and therapies. The participant maintained a stable level of independence in performing basic daily activities, indicating preserved functionality during the observation period. Although the expected improvement in physical mobility did not occur, maintaining a stable level of independence in basic ADLs, along with moderate satisfaction with quality of life, suggests that the physical exercise program helped her preserve existing functionality and prevent further deterioration. This is important because research by Vuori indicates that physical inactivity involves a lack of strong muscle contractions that stimulate muscle rebuilding, slows down metabolism hindering various metabolic regulations, and involves an insufficient amount of skilled movements to maintain motor control, etc. (28). A low degree of acceptance of physical appearance and frequent negative emotional states such as low mood, despair, anxiety, and depression were present. Results with scores of 2 and 3 indicate certain challenges in quality of life, particularly regarding emotional health and physical pain. Through one-on-one interviews with 13 women aged 60 to 69, Liechty found that women expressed dissatisfaction with their bodies and desired changes in their appearance, while simultaneously reporting overall satisfaction (29). Research also concludes that some women report their subjective ('felt') age is much younger than their chronological (actual) age, causing a sense of internal conflict regarding body/appearance expectations (30-32). Such results emphasize the need for additional psychological or emotional support to improve the participant's emotional well-being. Motor tests also show certain changes after the physical activity treatment. Comparing initial and final testing results, several significant improvements were noted in specific areas. Leg strength increased from 19 to 21 repetitions, while arm strength remained the same at 14 repetitions. Also, the endurance test showed improvement, increasing from 70 to 77 repetitions. The increase in leg strength after treatment suggests improved muscle function of the lower extremities, and the slight improvement in the endurance test are indicators of positive results that could contribute to better functional capacity and quality of life. The participant managed to maintain muscle mass while reducing body weight and body fat mass. Preserving muscle mass is crucial for maintaining maximal isometric strength, while reducing adipose tissue can improve specific muscle force by decreasing fat infiltration. Research by Frontera and Metter concludes that the decrease in maximal isometric

strength is associated with aging and largely parallels the loss of muscle mass (33, 34). Lower specific force (force per unit cross-sectional area) of limb muscles in older adults is partly explained by greater infiltration of adipose and connective tissue, which can be mitigated by physical activity (35). Other motor abilities, such as shoulder girdle and posterior thigh flexibility, showed minor changes, which may indicate limitations of the physical activity program or individual characteristics of the participant. Overall, the final testing results indicate minor increases in strength, endurance, and flexibility, while agility performance slightly declined. Although the magnitude is small, considering the age and number of treatments, these improvements may indicate a positive impact of kinesiotherapy or other therapeutic interventions on motor abilities. A case report by Krupalija, conducted on the same participant, with the same physical exercise program, intensity, and duration, but incorporating dry needling treatment during the exercise period, showed significantly greater effectiveness of dry needling treatment in improving motor abilities compared to this study's physical exercise treatment alone (36). These differences in results may be attributed to the assumption that a muscle first needs to be healthy to be subjected to physical activity. Specifically, a muscle affected by myofascial trigger points, when subjected to physical activity, may become even weaker. Therefore, dry needling treatment, which eliminates myofascial trigger points, can offer a significant advantage in improving motor abilities in patients. The pain scale showed no changes between initial and final testing, suggesting that physical activity did not have a significant impact on reducing pain in the hip and knee joints. These results may indicate the need for a different approach to pain management in this population, perhaps combining physical activity with other therapeutic methods.

The participant's vital signs remained stable throughout the observation period, indicating preserved physiological stability and good health status. There were no significant changes in these vital signs during the testing period; this confirms the safety of the implemented physical activity treatment and the absence of immediate negative effects on vital functions. Considering the participant's age and the duration of the treatment, it is possible that a greater number of sessions would be required to achieve more significant progress. Ultimately, although motor tests showed certain positive changes after the physical activity treatment, other indicators such as the Barthel Quality of Life test, pain scale, and body composition parameters did not show significant changes. These results suggest that physical activity can have varying effects on different aspects of health and functionality in older adults. Further research should investigate the specific mechanisms underlying these differences and identify the most effective strategies for improving quality of life in the older population. Including additional parameters such as psychological well-being or social support could provide deeper insight into the complex interactions between physical activity and health outcomes in older adults. This study highlights the complexity of the impact of physical activity on various aspects of health in older adults. Physical activity

could play a key role in mitigating the effects of aging on muscle mass and strength. These conclusions align with research showing that physical activity can help preserve muscle mass and strength in older adults by reducing the infiltration of adipose and connective tissue. The secondary objective, which included improving the participant's motor abilities and quality of life, was achieved to a lesser extent. The primary objective of the treatment, to reduce joint pain, was not achieved. Most likely, it was not achieved because the small number of treatment sessions did not lead to more significant changes.

## CONCLUSION

The research showed that the motor tests exhibited minor improvements after six physical activity treatment sessions, while no significant changes occurred in quality of life, vital signs, and body composition. This is most likely because physical activity can have selective effects on different aspects of health in older adults. Further research is needed with a larger sample size and a greater number of treatment sessions to better understand the mechanisms of action of physical activity and its impact on quality of life.

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# UČINCI TJELESNOG VJEŽBANJA NA BOL, MOTORIČKE SPOSOBNOSTI I KVALITETU ŽIVOTA KOD STARIJE ŽENE S KRONIČNOM BOLI: PRIKAZ SLUČAJA

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## SAŽETAK

Uvod**:** Tjelesna aktivnost ima potencijal poboljšati tjelesno i mentalno zdravlje starijih osoba, smanjujući rizik od bolova u zglobovima i invaliditeta. Prethodna istraživanja sugeriraju da redovito vježbanje jačanja mišića može poboljšati kvalitetu života, no kronična bol ostaje izazov koji negativno utječe na svakodnevne aktivnosti i socijalnu participaciju. Zbog važnosti održavanja tjelesne kondicije u starijoj dobi, preporučuju se prilagođeni programi tjelesne aktivnosti.

Cilj**:** Procijeniti utjecaj šest tretmana tjelesne aktivnosti na bol, motoričke sposobnosti i kvalitetu života starije žene s kroničnom boli u zglobu kuka i koljena.

Prikaz slučaja**:** Sudionica, starija žena od 74 godine, prijavila je kroničnu bol u kuku i koljenu. Tjelesna procjena uključivala je Senior Fitness Test, Barthelov indeks, NRS skalu boli, vitalne znakove i analizu sastava tijela. Nakon četiri tjedna terapije koja je obuhvaćala vježbe snage, istezanja i izdržljivosti, nije zabilježeno značajno poboljšanje pokretljivosti, ali su vitalni znakovi ostali stabilni. Intenzitet boli u zglobovima se nije smanjio.

Zaključak: Rezultati pokazuju da tjelesna aktivnost može imati selektivne učinke na različite aspekte zdravlja kod starijih osoba, ali za značajnije rezultate potrebna je kombinacija s drugim terapijama. Daljnja istraživanja s većim uzorcima i dužim trajanjem tretmana su potrebna kako bi se bolje razumjeli učinci tjelesne aktivnosti.

**Ključne riječi:** Senior fitness test, fizioterapija, tjelesno vježbanje, kvaliteta života

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