UDK 615.246:615.334-002-085.33 **Review Paper**
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POSTBIOTICS VERSUS PROBIOTICS: ANTIBACTERIAL EFFECT AND POTENTIAL USE AS ALTERNATIVE ANTIBIOTIC AGENTS

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Abstract: *Postbiotics, along with probiotics, are gaining increasing importance in scientific research primarily due to their antimicrobial effect and modulation of the intestinal microbiota. Unlike probiotics, which are defined as living organisms that confer health benefits when administered in adequate amounts, postbiotics are preparations of inanimate or inactivated microorganisms and/or their components (previously referred to as parabiotics), as well as their extracellular metabolites (such as short-chain fatty acids, lipids, proteins, antimicrobial peptides like bacteriocins, enzymes, hydrogen peroxide, and polysaccharides) that exert biological effects on the host. This review summarizes current knowledge about the antimicrobial mechanisms of action of probiotics and postbiotics, highlights their differences and advantages, and provides a critical view of safety challenges. The advantage of postbiotics over probiotics is that their use does not risk spreading antibiotic resistance nor translocating to sterile tissues and causing infections such as endocarditis or sepsis. The effectiveness of conventional antibiotics is increasingly limited due to bacterial resistance (multidrug resistance and pandrug resistance), and the slow development of new antibiotics further exacerbates this issue. Thus, this review specifically addresses the antibacterial effects of postbiotics against multidrug-resistant bacteria such as extended-spectrum beta-lactamase (ESBL)-producing Escherichia coli, Salmonella enterica serotype Typhimurium, Klebsiella pneumoniae, Staphylococcus aureus ATCC 25923, methicillin-resistant S. aureus (MRSA), Pseudomonas aeruginosa ATCC 27853, and P. aeruginosa PAO1. In addition to antimicrobial effects, postbiotics exhibit a wide range of other biological activities, including antioxidant, anti-inflammatory, antidiabetic, immunomodulatory, and antihypertensive effects. Since postbiotics do not contain live viable cells, they present fewer challenges regarding product stability compared to probiotics. Given all of the above, there is growing interest in alternative strategies for controlling bacterial infections and in discovering and using bioactive compounds of natural origin, including postbiotics, for innovative applications in the pharmaceutical, cosmetic, and food industries.*

Key words: *postbiotics, antibacterial strategy, advantages, innovative applications*

Introduction

According to data from the World Health Organization (WHO), antimicrobial resistance (AMR) is one of the ten global health problems of the 21st century [1]. If new effective solutions are not found, there is a risk of serious deterioration, with the number of annual deaths projected to reach 10 million by 2050 [2]. AMR is the broadest term for the resistance of microorganisms to drugs used to treat viral, parasitic, and fungal diseases, not just bacterial infections. The WHO's draft global action plan addresses antibiotic resistance and also refers to existing action plans for viral, parasitic, and bacterial diseases, including HIV/AIDS, malaria, and tuberculosis [3].

The greatest global challenge and threat to public health is posed by pathogenic bacterial strains that have developed antibiotic resistance [3]. Based on antibiotic resistance, bacteria are classified as follows: multiresistant (MDR – multidrug resistant), defined as acquired non-susceptibility to at least one agent in three or more antimicrobial categories; extensively resistant (XDR – extensively drug resistant), defined as non-susceptibility to at least one agent in all but two or fewer antimicrobial categories (i.e., bacterial isolates remain susceptible to only one or two categories); and panresistant (PDR – pandrug resistant), defined as non-susceptibility to all agents in all antimicrobial categories [4]. This resistance, resulting from bacteria adapting and growing in the presence of antibiotics and/or frequent antibiotic use, can lead to rapid and unpredictable spread of resistance to an entire related class of medicines, reducing the effectiveness of antibiotic treatment for a wide range of infections and diseases.

The rapid rise of AMR has rendered many conventional antibiotics ineffective, highlighting the need for alternative therapeutic strategies. Some probiotic strains have emerged as promising biotherapeutic agents capable of inhibiting MDR pathogens through various mechanisms. With their potential antibacterial effects, immunoregulatory and antihypertensive properties, anti-inflammatory and antioxidant activities, and ability to improve gut health [5], probiotics are becoming increasingly important not only in functional foods as natural preservatives and in cosmetic products, but also in biomedical and clinical research as potential pharmaceuticals [6-9]. In this context, postbiotics – functional, non-living byproducts or metabolic components generated by live probiotic strains – are a key factor in achieving these effects. This review summarizes current knowledge about the mechanisms of action and antimicrobial activity of postbiotics against various MDR bacterial strains, with critical comparisons to probiotics to highlight both the advantages and some limitations of their use. It is based on a search of scientific literature from the past 5 years in *PubMed*, *Scopus*, and *Google Scholar*, using key words such as postbiotics, antibacterial strategy, advantages, and innovative applications, with publication date filters applied and results sorted.

Probiotics versus postbiotics

The International Scientific Association on Probiotics and Prebiotics (ISAPP) defines probiotics as living organisms that provide health benefits when administered in adequate amounts, and postbiotics as preparations of non-living or inactivated microorganisms and/or their components (previously called parabiotics), as well as their extracellular metabolites (such as short-chain fatty acids (SCFA), lipids, proteins, antimicrobial peptides like bacteriocins, enzymes, hydrogen peroxide, and polysaccharides) that have biological effects on the host [10-12]. Mechanisms of live action of probiotics include: (1) Competitive exclusion – outcompeting pathogens for essential nutrients and physical adhesion sites on the intestinal epithelium; (2) Virulence quorum-quenching – disrupting the communication systems (quorum sensing – QS) of harmful bacteria, preventing biofilm formation and pathogen virulence; and (3) Immunomodulation – stimulating host cells to secrete protective antimicrobial peptides and upregulate mucosal immunity to strengthen the intestinal barrier. Mechanisms of metabolite action of postbiotics include: (1) Membrane disruption and lysis (particularly by those rich in lactic and acetic acids) – altering pH and physically disrupting pathogen cell membranes, leading to lethal intracellular leakage and DNA degradation; (2) Bacteriocin secretion (such as nisin) – specifically targeting and decolonizing pathogens without disturbing beneficial commensal microbiota; and (3) Barrier reinforcement (such as SCFA) – acting as cellular signaling molecules, tightening epithelial junctions and reinforcing physical defenses against invading bacteria.

Probiotics are produced by cultivating microorganisms, primarily bacteria, with yeasts limited to *Saccharomyces cerevisiae* var. Boulardii, in a nutrient medium (commonly referred to as fermentation), followed by biomass separation (centrifugation), lyophilization (after adding lyoprotectants and bioprotectants), or encapsulation [13]. Since most bacteria are present only in vegetative form (not spore-forming), maintaining product stability and the viability of probiotic bacteria throughout the product's shelf life is a particular challenge. Lactic acid bacteria are the most widely used microorganisms in global food fermentation and preservation. The production of postbiotics is preceded by the fermentation and cultivation of bacteria in a nutrient medium, followed by separation of the bacteria (biomass), inactivation of cells (thermal or UV), disintegration and lysis of cells (mechanical or enzymatic) by filtration after tyndallization or cell lysis procedures [14].

Previously, parabiotics referred to inactivated probiotics and their fragments (exopolysaccharides, peptidoglycans, and lipoteichoic acid), while postbiotics referred to metabolic products, including extracellular metabolites (SCFA, lipids, and proteins), antimicrobial peptides (bacteriocins), enzymes, hydrogen peroxide, and exopolysaccharides [15]. There are different criteria for classifying postbiotics, including the metabolites they produce (such as SCFA, exopolysaccharides, cell wall fragments, enzymes/proteins, and other metabolites), their chemical structure (such as peptides, teichoic acids, and plasmalogens), and their physiological function (such

as anti-obesogenic, antioxidant, anti-inflammatory, hypocholesterolemic, anti-hypersensitive, and anti-proliferative effects exhibiting immunomodulatory properties) [16]. Common types of postbiotics, also known as metabiotics, include paraprobiotics or "ghost probiotics" and fermented infant formula [17].

Generally Recognized as Safe (GRAS) status, granted by the Food and Drug Administration (FDA), indicates that a substance is recognized as safe for use based on long-term experience or scientific evidence [18]. For probiotics, this status has been assigned to many strains, such as *Lactobacillus* and *Bifidobacterium*, due to their natural presence in the human body and proven health benefits. A similar European concept, known as Qualified Presumption of Safety (QPS), provides further confirmation of safety by analyzing genetic characteristics, the potential for toxin production (which must not be present), and AMR in microorganisms (which must not carry antibiotic resistance genes). These assessments play a key role in ensuring that probiotics and postbiotics can be used without risk to users' health [19]. Guidelines for qualifying a preparation as a postbiotic include: (1) molecular characterization of the progenitor microorganisms, with identification and screening of potential genes that may raise safety concerns; (2) description of the inactivation process with confirmation that inactivation has occurred; (3) detailed description of the composition of the postbiotic preparation; (4) assessment of the safety of the postbiotic in the target host; and (5) evidence of health benefits in the host from studies [11].

Combining probiotics and postbiotics may offer new opportunities for developing potential therapeutic approaches. These combinations could create a synergistic effect in preventing and treating infections by allowing live microorganisms (probiotics) to improve host health, while their bioactive metabolites (postbiotics) offer additional benefits through their activity, stability, and ease of application [10].

Antimicrobial potential of postbiotics

Postbiotics derived from bacteria belonging to the genera *Bifidobacterium*, *Lactobacillus* (reclassified into 25 genera, including the emended genus *Lactobacillus*, which comprises host-adapted organisms previously referred to as the *Lactobacillus delbrueckii* group, *Paralactobacillus*, and 23 novel genera [20]), *Lactococcus*, and *Bacillus* are effective against a broad spectrum of bacteria, including multidrug-resistant strains such as extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli*, *Salmonella enterica* serotype Typhimurium, *Klebsiella pneumoniae*, *Staphylococcus aureus* ATCC 25923, methicillin-resistant *S. aureus* (MRSA), *Pseudomonas aeruginosa* ATCC 27853, and *P. aeruginosa* PAO1 (Figure 1).

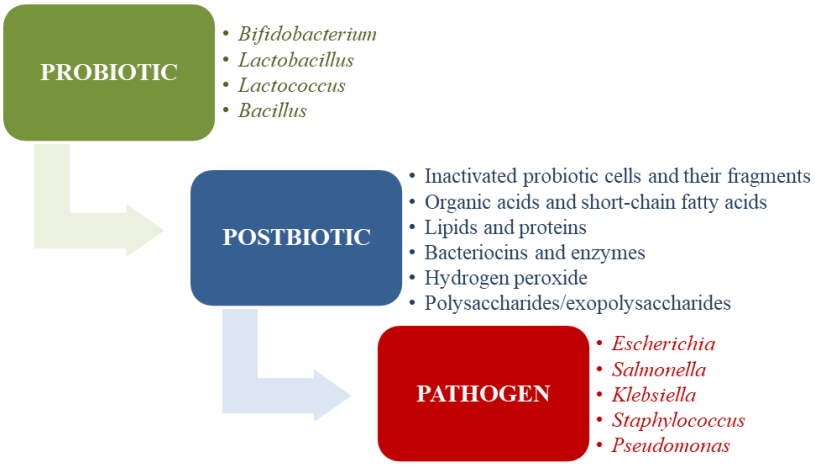

Figure 1. Antimicrobial strategy – from probiotic, via postbiotic, to pathogen

Antimicrobial strategies against gram-positive and gram-negative bacteria differ significantly [21]. The fundamental difference in susceptibility between these bacteria lies in their cell wall structure [22-23]. Gram-positive bacteria have a thick, porous peptidoglycan layer that allows antimicrobial drugs to pass freely, while gram-negative bacteria are more resistant due to their structure, specifically an impermeable outer lipopolysaccharide membrane and multiple efflux pumps.

Four main mechanisms drive bacterial AMR: (1) Limitation of drug uptake, (2) Modification of the drug target, (3) Drug inactivation, and (4) Active drug efflux [24]. To overcome bacterial AMR, postbiotics act in several ways: (1) Membrane disruption, which lowers local pH and physically penetrates the bacterial cell membrane, leading to the destruction of vital intracellular components; (2) Biofilm eradication, which disperses and destroys mature biofilms, making the remaining bacteria vulnerable to immune clearance or antibiotic action; and (3) Quorum quenching, which interferes with bacterial communication systems, reducing virulence expression and resistance [25]. Since postbiotics encompass various inanimate microbes and their byproducts, each specific type employs distinct mechanisms to counter bacterial AMR (Table 1).

Table 1. Antibacterial potential of postbiotics based on their chemical structure

Probiotic	**Postbiotic**	**Pathogen**	**Antibacterial effect**	**Ref.**
B. amyloliquefaciens J *L. plantarum* SN4	Lactic acid and acetic acid	*E. coli* *S. aureus* *S. typhimurium*	Disrupting bacterial cell membranes and preventing infestation of the host by inhibiting bacterial adhesion	[26]
L. casei subsp. *casei* PTCC 1608	Lactic acid	*P. aeruginosa*	QS-modulated signaling of pathogens	[27]

L. plantarum LP1812	Acetic acid	Carbapenem-resistant *K. pneumoniae* (CRKP)	Regulating the intestinal microbiota and inhibiting CRKP	[28]
Lactiplantibacillus plantarum (formerly *L. plantarum*)	Organic acids, free amino acids, free fatty acids, polyphenols, and volatiles	*S. enterica* serotype Typhimurium	Attenuating bacterial invasion and modulating innate immune response mechanisms	[29]
L. paraplantarum CRL 1905 *L. brevis* CRL 1942 *L. fermentum* CRL 973 *L. helveticus* ATCC 15009 *L. acidophilus* ATCC 4356	Organic acids and/or proteinaceous molecules	*S. aureus* *P. aeruginosa*	Inhibiting biofilm formation and partially disrupting mature biofilms	[30]
L. paracasei BGP1	Palmitic acid and stearic acid	*S. aureus* ATCC 25923 *P. aeruginosa* ATCC 27853 *P. aeruginosa* PAO1 MRSA	Inhibitory and bactericidal	[31]
L. acidophilus	Bacteriocin	*K. pneumoniae* *S. aureus* *E. coli* *P. aeruginosa*	Inhibiting the growth of pathogenic bacteria	[32]
L. rhamnosus CW40	Bacteriocin	*B. subtilis* *B. cereus* *E. coli*	Antimicrobial activity	[33]
L. plantarum *L. lactis*	Bacteriocins	ESBL-producing *E. coli*	Bacteriostatic and/or bactericidal	[34]
L. rhamnosus KC3	Bacteriocins	*E. coli* (CR-APEC) MRSA	Suppressing biofilm formation and bacteriostatic activity	[35]
Bacillus	Lipopeptides	*S. aureus*	Inhibiting the QS process	[36]
B. subtilis 6D1	Peptides	*S. aureus*	Inhibiting biofilm growth, disassembling mature biofilms, and improving antibiotic sensitivity of biofilms through the QS interference mechanism	[37]
E. coli Nissle 1917	Lipopolysaccharides	*P. aeruginosa*	Inhibiting biofilm formation and mitigating virulence	[38]
L. fermentum KT998657	Bacteriocin and exopolysaccharides	*P. aeruginosa* PAO1	Inhibiting biofilm growth	[39]

Advantages of postbiotics over probiotics

Side effects of probiotics are rare and usually include bloating, gas, diarrhea, constipation, or nausea [40]. Additionally, there is a risk of translocation of probiotics as living microorganisms, especially in immunocompromised individuals, causing infections such as bacteremia, fungemia, endocarditis, or sepsis [41]. Another risk is the possibility of antibiotic resistance gene transfer [42-43].

The advantages of postbiotics over live probiotics include greater stability, safety, ease of application, direct action without requiring bacterial colonization, standardized dosing, and longer shelf life [10]. Unlike live probiotics, postbiotics do not require specific storage conditions and are not subject to variations in efficacy due to changes in the host's physiological conditions. They are especially useful when it is necessary to avoid the risks associated with using live microorganisms in immunocompromised patients [44]. Despite the multiple demonstrated antimicrobial activities of postbiotics, key knowledge gaps remain, including mechanisms of action, standardization and classification, dosing and efficacy, and regulatory framework.

Conclusion

Given the growing threat of AMR, probiotic-derived postbiotics are becoming increasingly important as alternatives or additions to traditional therapies, serving as safe and stable non-antibiotic agents for controlling multidrug-resistant pathogens. Their ability to reduce antibiotic use, lower infection risk, and improve overall health makes them a key component of health-preserving and infection-fighting strategies. To better understand the mechanisms of action and safety of postbiotics, continued research and innovation are necessary. Detailed metabolic analyses and validation of the effectiveness and safety of postbiotics in mammalian models to assess their biotherapeutic potential will support the development of new products and therapeutic approaches, further strengthening their role in modern medicine, cosmetics, food, and pharmacy.

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POSTBIOTICI PREMA PROBIOTICIMA: ANTIBAKTERIJSKI EFEKAT I POTENCIJALNA UPOTREBA KAO ALTERNATIVNIH ANTIBIOTSKIH AGENASA

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Sažetak. *Postbiotici, zajedno s probioticima, dobijaju sve veći značaj u naučnim istraživanjima prvenstveno zbog antimikrobnog efekta i modulacije crijevne mikrobiote. Za razliku od probiotika, koji se definišu kao živi organizmi koji pružaju zdravstvene koristi kada se primjenjuju u adekvatnim količinama, postbiotici su preparati neživih ili inaktiviranih mikroorganizama i/ili njihovih komponenti (ranije nazivanih parabioticima), kao i njihovih ekstraćelijskih metabolita (kratkolančane masne kiseline, lipidi, proteini, antimikrobni peptidi poput bakteriocina, enzimi, vodonik peroksid i polisaharidi) koji imaju biološke efekte na domaćina. Ovaj pregled sažima trenutna znanja o antimikrobnim mehanizmima djelovanja probiotika i postbiotika, ističe njihove razlike i prednosti i pruža kritički pogled na sigurnosne izazove. Prednost postbiotika u odnosu na probiotike je što pri njihovoj upotrebi nema rizika od širenja rezistencije na antibiotike, kao ni translokacije u sterilna tkiva i izazivanja infekcije poput endokarditisa ili sepse. Efikasnost konvencionalnih antibiotika sve je ograničenija zbog bakterijske rezistencije (višestruka rezistencija i panrezistencija na antibiotike), a spor razvoj novih antibiotika dodatno pogoršava ovaj problem. Stoga su u ovom revijalnom radu posebno obrađeni antibakterijski efekti postbiotika protiv multirezistentnih bakterija kao što su Escherichia coli koja proizvodi beta-laktamaze proširenog spektra (ESBL), Salmonella enterica serotip Typhimurium, Klebsiella pneumoniae, Staphylococcus aureus ATCC 25923, meticilin-rezistentni S. aureus (MRSA), Pseudomonas aeruginosa ATCC 27853 i P. aeruginosa PAO1. Pored antimikrobnih efekata, postbiotici pokazuju i širok spektar drugih bioloških aktivnosti, uključujući antioksidativne, antiinflamatorne, antidijabetičke, imunomodulatorne i antihipertenzivne efekte. Budući da postbiotici ne sadrže žive vijabilne ćelije, predstavljaju manje izazova u pogledu stabilnosti proizvoda u poređenju sa probioticima. S obzirom na sve navedeno, postoji sve veći interes za alternativne strategije kontrole bakterijskih infekcija i za otkrivanje i korišćenje bioaktivnih jedinjenja prirodnog porijekla, uključujući postbiotike, za inovativne primjene u farmaceutskoj, kozmetičkoj i prehrambenoj industriji.*

Ključne riječi*: postbiotici, antibakterijska strategija, prednosti, inovativne primjene*

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THE IMPACT OF NURSING ASSOCIATIONS AND JOURNALS ON THE DEVELOPMENT OF RESEARCG CULTURE IN NURSING

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Abstract. *The path to health lies in continuous research and the acquisition of new knowledge. The purpose of nursing research is to add new knowledge to the existing body of knowledge in nursing. The aim of this paper was to present the impact of nursing associations and journals on the development of a research culture among nurses and nursing technicians. Nursing associations play a key and multidimensional role in developing a research culture in nursing, as they act as a bridge between clinical practice, education, and scientific research. Activities such as seminars, workshops, congresses, and conferences are organized, where nurses are introduced to contemporary research methods, data analysis, and principles of scientific writing, which contributes to the development of research competencies, especially among nurses who do not have formal education in scientific research. This reduces the gap between theory and practice and strengthens readiness to apply scientific evidence in everyday work. Nursing associations provide support in conducting research, including mentorship, methodological guidance, assistance in writing papers, and encouragement of publication in professional and scientific journals, thereby increasing the visibility of the nursing profession in the academic and broader social community, and affirming nurses as active contributors to knowledge creation. Networking of associations through cooperation with national and international organizations, universities, and research centers enables the exchange of experiences, joint projects, and access to contemporary trends in nursing, which strengthens research culture, awareness, and the development of a global perspective of the profession. Research awareness includes recognition that knowledge gained through research can have significant implications for both nurses and patients. An example of such practice is the newly established scientific-professional journal* NurseNexus Journal *in Republika Srpska. The journal represents an available source of documentation and a place where different strands of nursing work* theory, practice, and science *are brought together. Knowledge gained through science is power, and in the context of health, it is also a responsibility. Associations and journals have an advocacy role in promoting research culture in nursing, influencing health policies, and encouraging investment in the development of science and the education of nurses. In this way, they contribute to building professional identity and strengthening the position of nursing as an independent, scientifically grounded discipline.*

Keywords: *Nursing associations, journals, research, nurses.*

Introduction

The path to health leads through continuous research and the adoption of new knowledge. The purpose of nursing research is to add new knowledge to the existing body of knowledge available within nursing. Nurses and nursing technicians represent the foundation of every healthcare system and play a key role in delivering high-quality healthcare. Over the past fifteen years, many countries have made significant progress in improving their professional status through the development of educational programs, changes in health policies, and improvements in the financial status of employees [1]. Despite this, a large number of nurses and technicians still work under difficult conditions, with limited opportunities for professional development, insufficient professional support, and inadequate social recognition of their profession [1–4].

Nursing associations play a key and multidimensional role in the development of a research culture in nursing, as they act as a bridge between clinical practice, education, and scientific research. They organize activities such as seminars, workshops, congresses, and conferences, where nurses are introduced to modern research methods, data analysis, and principles of scientific writing. This contributes to the development of research competencies, especially among nurses who do not have formal education in research methodology. In this way, the gap between theory and practice is reduced, and readiness to apply scientific evidence in everyday practice is strengthened.

The aim of this paper was to present the impact of nursing associations and journals on the development of a research culture among nurses and nursing technicians.

Review of Available Studies

Numerous studies indicate that healthcare professionals in the nursing field face staff shortages, increased workload, inadequate equipment, and limited material resources, which negatively affects the quality of care and patient safety [2,5]. Prolonged exposure to such working conditions contributes to professional burnout, reduced job satisfaction, and an increased intention to leave the workplace or migrate to more developed countries that offer better working conditions and opportunities for professional advancement [1,6].

The global unequal distribution of healthcare workers further exacerbates this problem. High-income countries have a significantly higher number of nurses compared to low-income countries, which represents a serious challenge for the functioning of healthcare systems and access to quality care [7]. The shortage of nurses is particularly evident in countries facing a high burden of infectious and chronic diseases, where limited human resources directly affect treatment outcomes and the quality of care provided [8–11].

Professional nursing associations play an important role in improving the status of the profession and the development of nursing. Through advocacy for the interests of their members, participation in health policy development, organization of continuing education, and strengthening of professional competencies, these associations contribute to improving healthcare quality and the development of the nursing profession [12,13]. Numerous studies show that strengthening the organizational capacities of professional associations improves their ability to support members, develop professional standards, and participate in health policy-making [12]. The importance of institutional capacity development has also been recognized by the World Health Organization, which emphasizes that improving governance, strategic planning, monitoring, and evaluation is one of the key prerequisites for strengthening health systems [14,15].

In line with these recommendations, numerous international programs have been developed aimed at strengthening professional nursing and midwifery associations. One of the most significant programs was the African Health Regulatory Collaborative for Nurses and Midwives (ARC), which demonstrated that improving leadership, management, strategic planning, and organizational capacity contributes to strengthening professional associations and improving regulatory processes in nursing and midwifery [6,16]. Research also shows that continuous education, mentorship, and the development of research competencies significantly contribute to the professional development of nurses and the improvement of healthcare quality [17–21]. Although there is substantial evidence of the importance of professional associations for the development of nursing, research evaluating the effects of strengthening their organizational capacities and their impact on work quality remains limited [22].

A program aimed at strengthening nursing professional associations has shown a significant contribution to improving their organizational capacities. The greatest progress was achieved in the areas of resource mobilization, financial management, strategic planning, as well as monitoring and evaluation. Thanks to acquired knowledge and skills, associations became more capable of independently planning activities, managing available resources more efficiently, and ensuring the sustainability of their work. Interestingly, participants reported improved research competencies, although the development of research activity was not among the main objectives of the program. During training on resource mobilization, the importance of research as a potential source of funding and professional development was emphasized, which increased interest in this area. At the same time, it was shown that most members of professional associations have limited experience in conducting scientific research, which is linked to the small number of members holding master's or doctoral degrees [23].

Significant progress was also achieved in the area of monitoring and evaluation. Although respondents did not initially express a need for additional training in this area, they assessed that their competencies had significantly improved after the training sessions. It is possible that participants were not fully familiar with all aspects

of monitoring and evaluation, and therefore did not recognize the need for further education. On the other hand, training in financial management proved highly useful, as individuals responsible for financial tasks acquired practical knowledge they previously lacked, which improved the financial operations of their associations [24, 25].

The findings of the research also confirm the recommendations of the World Health Organization, which highlight the importance of collaboration between professional associations, regulatory bodies, and other organizations involved in the development of the nursing profession [7]. The program contributed to strengthening cooperation between associations through joint trainings, workshops, and exchange of experiences. Improved organizational capacities increased the credibility of associations and their ability to more actively participate in health policy development and advocate for the interests of nurses and technicians.

The beginnings of nursing research are associated with Florence Nightingale. In her work, she studied the impact of various environmental factors on achieving and maintaining mental and physical health. Her research on drinking water quality, sanitation conditions, proper nutrition, mortality, and morbidity had a significant impact on health in many communities. Nursing associations provide support for research activities, including mentorship, methodological guidance, assistance in writing papers, and encouragement to publish in professional and scientific journals, thereby increasing the visibility of the nursing profession in academic and social communities. Nurses are thus affirmed as active participants in knowledge creation. Through networking and cooperation with national and international organizations, universities, and research centers, nursing associations enable the exchange of experience, joint projects, and access to contemporary trends in nursing, which strengthens research culture, awareness, and the development of a global perspective of the profession.

In Bosnia and Herzegovina, there are numerous factors that hinder the implementation of scientific research and the application of research findings in nursing practice. Some barriers relate to nurses themselves and their professional preparedness, including insufficient theoretical and practical knowledge in research methodology, lack of experience in applying evidence in everyday practice, negative attitudes toward nursing research, and low motivation and professional satisfaction. In addition to individual factors, organizational conditions within healthcare institutions also play a significant role. An insufficient number of nurses, heavy workload, dominance of administrative and routine tasks, inadequate recognition of the nursing profession, poor work organization, weak interprofessional collaboration, and inadequate implementation of clearly defined nursing standards represent serious obstacles to the development of a research culture. Broader social and economic factors also influence the development of scientific research. Low salaries, limited opportunities for professional advancement, migration of nurses to more developed countries due to better working conditions, as well as nepotism and other systemic issues, further reduce motivation for professional development and involvement in

research activities. All of the above slows down the development of evidence-based nursing and hinders the improvement of healthcare quality.

Research awareness includes the recognition that knowledge gained through research can have significant implications for both nurses and patients. An example of such practice is the newly established scientific-professional journal *NurseNexus Journal* in the Republic of Srpska. The journal publishes articles in English and Republic of Serbian, and it is issued twice a year. There is no publication fee. The publisher of the journal is the Association of Graduate Nurses of Health Care of the Republic of Srpska, Bosnia and Herzegovina (URL: https://nursenexusjournal.com/). The journal serves as a platform where different aspects of nursing work intersect: theory, practice, and science. The launch of a scientific-professional journal intended for nurses represents an important opportunity for developing research competencies and improving professional practice, as well as for learning how to write scientific and professional papers under the mentorship and educational support of a nursing association as the journal's publisher. Publishing in a nursing journal contributes to the dissemination of knowledge, the application of evidence-based practice, and the strengthening of the professional identity of nurses and technicians. Therefore, it is necessary to further explore ways in which professional associations can contribute to improving nurses' competencies, the quality of healthcare, and the development of health systems.

Conclusion

Evidence-based nursing refers to the integration of knowledge and skills through which nurses make clinical decisions based on the best available scientific evidence, clinical experience, patient preferences and attitudes, and available resources. Knowledge derived from science is power, and in the context of health it is also a responsibility. Nursing associations and journals have an advocacy role in promoting a research culture in nursing, influencing health policies, and supporting investment in the development of science and education of nurses. In this way, they contribute to building professional identity and strengthening the position of nursing as an independent and scientifically grounded discipline. We believe that NurseNexus Journal will awaken the research awareness of nurses and medical technicians in Bosnia and Herzegovina, and beyond.

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UTICAJ SESTRINSKIH UDRUŽENJA I ČASOPISA NA RAZVOJ ISTRAŽIVAČKE KULTURE U SESTRINSTVU

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Sažetak. *Put ka zdravlju vodi kroz stalna istraživanja i usvajanja novih znanja. Svrha sestrinskih istraživanja je dodavanje novog znanja već postojećem fondu znanja kojim sestrinstvo raspolaže. Cilj ovog rada bio je prikazati uticaj sestrinskih udruženja i časopisa na razvoj istraživačke kulture kod medicinskih sestara i tehničara. Sestrinska udruženja imaju ključnu i višedimenzionalnu ulogu u razvoju istraživačke kulture u sestrinstvu, jer djeluju kao most između kliničke prakse, obrazovanja i naučnoistraživačkog rada. Organizuju se aktivnosti poput seminara, radionica, kongresa i konferencija, gdje se medicinske sestre upoznaju sa savremenim istraživačkim metodama, analizom podataka i principima naučnog pisanja, što doprinosi razvoju istraživačkih kompetencija, posebno kod sestara koje nemaju formalno obrazovanje u oblasti naučnoistraživačkog rada. To smanjuje jaz između teorije i prakse, jača spremnost za primjenu naučnih dokaza u svakodnevnom radu. Sestrinska udruženja pružaju podršku u realizaciji istraživanja što uključuje mentorstvo, savjetovanje u vezi sa metodologijom, pomoć pri pisanju radova, kao i podsticanje publikovanja u stručnim i naučnim časopisima, povećava se vidljivost sestrinske profesije u akademskoj i društvenoj zajednici, medicinske sestre se afirmišu kao aktivni učesnici u stvaranju znanja. Umrežavanje udruženja kroz saradnju sa domaćim i međunarodnim organizacijama, univerzitetima i istraživačkim centrima, sestrinska udruženja omogućavaju razmjenu iskustava, zajedničke projekte i pristup savremenim trendovima u sestrinstvu što jača istraživačku kulturu i svijest i razvoj globalne perspektive profesije. Istraživačka svijest obuhvata priznanje da znanje stečeno kroz istraživanje može imati značajne implikacije kako za sestre tako i za pacijente. Primjer takve prakse je novoregistrovani naučno-stručni časopis NurseNexus Journal u Republici Srpskoj. Časopis predstavlja raspoloživu dokumentaciju i mjesto gdje se nalaze različite niti sestrinskog rada: teorija, praksa i nauka. Znanje koje se dobija i pomoću nauke je moć, a u kontekstu zdravlja ono je i odgovornost. Udruženja i časopisi imaju zagovaračku ulogu u promociji istraživačke kulture u sestrinstvu, utiču na zdravstvene politike i promovišu ulaganje u razvoj nauke i obrazovanja medicinskih sestara. Time doprinose izgradnji profesionalnog identiteta i jačanju pozicije sestrinstva kao samostalne i naučno utemeljene discipline.*

Ključne riječi: *Sestrinska udruženja, časopisi, istraživanje, medicinske sestre.*