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PHYSIOTHERAPY AND HEALTH SCIENCES
Peer-Reviewed Proceedings Book

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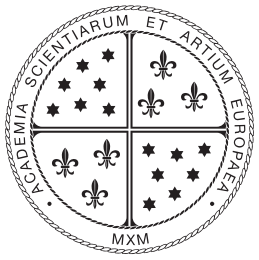

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ALMA MATER
PRESS

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IT'S ABOUT PEOPLE

2025: Social and Technological Resilience for Health and Sustainable Development

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EDITORIAL INTRODUCTION

The present peer-reviewed proceedings of the International Scientific Conference It's About People 2025 bring together a diverse and intellectually stimulating collection of contributions that reflect the evolving intersections of health sciences, technology, management, and societal development. Framed by the overarching themes of sustainability, dignity, and social and technological resilience for health, this volume embodies a clear and timely message: scientific progress must ultimately serve people. The chapters included in this edition demonstrate both disciplinary depth and interdisciplinary breadth. Contributions span physiotherapy, clinical and public health research, biomedical innovation, nanomedicine, ergonomics, digital and remote healthcare, robotics in dementia care, medication safety, and strategic and technological management approaches. Such diversity is not incidental; rather, it reflects the contemporary reality of healthcare and societal systems, where complex challenges require integrated, evidence-based, and ethically grounded responses. Several papers focus on advancing clinical knowledge and patient-centred care. Studies addressing remote physiotherapy for musculoskeletal conditions, early neurodevelopmental interventions, biochemical monitoring in chronic respiratory diseases during and after COVID-19, and the application of socially assistive robotics in dementia care illustrate the ongoing transformation of healthcare delivery. These contributions highlight a shared commitment to rigorous methodology, critical analysis, and practical applicability. Importantly, they also underscore the necessity of translating scientific evidence into improved patient outcomes, enhanced safety, and higher quality of life.

At the same time, technological innovation emerges as a central theme. The exploration of nanomedicine milestones and targeted drug delivery systems, the analysis of artificial intelligence and robotic interventions, and discussions on digital systems for reducing medication errors demonstrate how technological advancement can reshape both diagnostics and therapeutic strategies. However, this volume does not treat technology as an end in itself. Instead, it consistently emphasises safety considerations, ethical responsibility, and the human dimension of care-reminding us that innovation must remain aligned with dignity, accountability, and sustainability. Equally significant are contributions examining organisational culture, error-reporting systems, ergonomics for work-life balance, and strategic communication. These studies recognise that healthcare quality depends not only on clinical competence but also on system design, leadership, interprofessional collaboration, and safe working environments. The analysis of medication-handling errors, for example, reinforces the global imperative to strengthen patient safety frameworks and foster non-punitive cultures that encourage transparency and learning. In this respect, the proceedings echo international priorities in healthcare governance and quality improvement. What unites all contributions is a strong methodological awareness. Authors employ qualitative reviews, cross-sectional and retrospective studies, systematic reviews following PRISMA guidelines, and statistical analyses using contemporary software tools. This methodological rigour reflects the maturing academic culture of our region and the increasing alignment with international scientific standards.

The conference title, It's About People, is therefore not merely symbolic. It serves as a reminder that sustainability, technological progress, and organisational excellence must ultimately contribute to human well-being. Whether addressing elderly individuals with dementia, patients with chronic diseases, parents of children requiring early intervention, healthcare professionals striving for safer systems, or societies navigating post-pandemic realities, the central focus remains clear: the advancement of knowledge in the service of people.

As Editor, I would like to express my sincere appreciation to all authors, reviewers, and members of the editorial and technical teams for their scholarly dedication and collaborative spirit. Their efforts have resulted in a volume that not only documents current research and professional reflections but also stimulates further inquiry and interdisciplinary dialogue. This proceedings book will inspire critical thinking, encourage innovation grounded in responsibility, and strengthen cooperation across disciplines and borders. May it serve as a platform for continued scientific excellence and as a catalyst for resilient, sustainable, and people-centred development in health and beyond.

Asst. Prof. Tine Kovačič, PhD

PHYSIOTHERAPY

1.09 Objavljeni strokovni prispevek na konferenci
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ZDRAVLJENJE MIŠIČNO-SKELETNIH POŠKODB S FIZIOTERAPIJO NA DALJAVO – PREGLED LITERATURE

TREATMENT OF MUSCULOSKELETAL INJURIES WITH REMOTE PHYSIOTHERAPY – LITERATURE REVIEW

Lara Trobec

Mladen Herc
Alma Mater Europaea University – Faculty ECM, Slovenia

POVZETEK

Teoretična izhodišča: Mišično-skeletne poškodbe so poškodbe, ki prizadenejo sklepe, kosti, mišice in druge mehko tkivne strukture, ki tvorijo lokomotorni sistem.

So eden najpogostejših vzrokov za potrebe po rehabilitaciji ter fizioterapevtski obravnavi. Prizadenejo lahko vsakogar in mu nižajo kvaliteto življenja. V raziskavi smo opisali, kaj sploh so mišično-skeletne poškodbe, kako jih konvencionalno obravnavamo, kaj je telerehabilitacija in fizioterapija na daljavo, ter ugotavljali, kako lahko s fizioterapijo na daljavo obravnavamo mišično-skeletne poškodbe.

Metoda: V raziskavi smo uporabili kvalitativno metodologijo. V teoretičnem delu smo povzemali podatke iz pregledane strokovne in znanstvene literature ter jih predstavili z metodo opisovanja. V empiričnem delu pa smo pregledano strokovno in znanstveno literaturo, ki smo jo izbrali s pomočjo sistema PRIZMA, analizirali, opisali in primerjali.

Rezultati: Po pregledu izbrane strokovne in znanstvene literature smo ugotovili, da je fizioterapija na daljavo pri obravnavi mišično-skeletnih poškodb učinkovita ter primerljiva s fizioterapijo v živo. V raziskavah ni bilo ugotovljenih statistično pomembnih razlik med obema oblikama terapije. Kljub različnim pristopom in meritvam, ki so jih avtorji vključenih študij uporabljali, smo ugotovili, da je povprečna učinkovitost rehabilitacije na daljavo v primerjavi s fizioterapijo v živo – ob meritvah funkcije pri nastavljenem intervalu zaupanja 95% in p = 0.05 – znašala približno 1.2 (95% IZ; -13,5 do 9,8; p = 0,4). Od vseh raziskav vključenih v diplomsko delo se je fizioterapija na daljavo v 50% izkazala kot primerljiva, v 50% pa celo boljša kot fizioterapija v živo.

Razprava: Po natančnem pregledu vseh člankov smo ugotovili, da je veliko načinov izvajanja fizioterapije na daljavo, da je le-ta primerljiva s konvencionalno fizioterapijo ter da je učinkovita in izvedljiva.

Ključne besede: *fizioterapija na daljavo, telezdravje, telerehabilitacija, mišično-skeletne motnje, mišično-skeletne poškodbe*

ABSTRACT

Theoretical background: Musculoskeletal injuries are injuries that affect joints, bones, muscles and other soft-tissue structures that make up the locomotor system. They are one of the most common causes of the need for rehabilitation and physiotherapy treatment. They can affect anyone at any age and reduce their quality of life. In this thesis we describe what musculoskeletal injuries are, how they are conventionally treated, what tele-rehabilitation and tele-physiotherapy are and how tele-physiotherapy can treat musculoskeletal injuries.

Method: In the theoretical part, we summarised data from the reviewed professional and scientific literature and presented them using the descriptive method. In the empirical part, we analysed, described and compared the reviewed professional and scientific literature, which we selected using the PRIZMA system.

Results: After reviewing selected professional and scientific literature, we have concluded that tele-physiotherapy is effective and comparable to face-to-face physiotherapy in the treatment of musculoskeletal injuries. In the studies, no significant differences were found between the two forms of therapy. Despite the different approaches and metrics used by the authors of the included studies used, we found that the average effectiveness of telerehabilitation in comparison with face-to-face physiotherapy on measures of function, at a set confidence interval of 95% and p = 0.05, was approximately 1.2 (95% CI; -13.5 to 9.8; p = 0.4). Of all the studies included in the thesis, tele-physiotherapy was found to be comparable in 50% and even better than face-to-face physiotherapy in 50%.

Discussion: After a careful review of all the articles, we found that there are many advantages of remote delivery of physiotherapy, that it is comparable to conventional physiotherapy, and that it is effective and feasible.

Keywords: *Tele-physiotherapy, Telehealth, Tele-rehabilitation, Musculoskeletal disorders, Musculoskeletal injuries*

1 UVOD

Mišično-skeletne poškodbe prizadenejo sklepe, kosti, mišice in druge mehkotkivne strukture, ki tvorijo lokomotorni sistem. Poznamo več kot 150 različnih mišično-skeletnih stanj, nekatera od teh so razni artritisi, osteoporoza, travmatične poškodbe, kot so npr. zlomi, sarkopenia, obremenitvene poškodbe, fibromialgija idr. (World Health Organisation 2022). Čeprav mišično-skeletne poškodbe niso življenjsko ogrožajoče, močno vplivajo na kvaliteto življenja posameznika. Na svetovni ravni so en glavnih vzrokov invalidnosti ter potreb po rehabilitaciji, največje breme pa predstavljajo v Evropi (Sebbag idr. 2019; Cieza idr. 2021; Jette 2021). Incidenca mišično-skeletnih motenj se s starostjo viša, a so mišično-skeletne poškodbe stanja, ki lahko prizadenejo vsakega posameznika, tako otroka kot mladostnika ali starostnika (World Health Organisation 2022). Naloga fizioterapevta je vzdrževati, znova vzpostaviti ali razvijati optimalno zdravje lokomotornega sistema, gibljivosti in funkcijske sposobnosti oseb iz vseh starostnih skupin. Fizioterapevt obravnava funkcijske sposobnosti posameznikov glede na starost, poškodbe, bolezni, splošno zdravstveno stanje, okvare in okoljske dejavnike. Fizioterapevt stremi k izboljšanju kvalitete življenja vsakega posameznika. Deluje na področju promocije zdravja, habilitacije, preventive, zdravljenja in rehabilitacije. Fizioterapevt izvaja preiskavo oziroma oceni stanje pacienta in nato postavi fizioterapevtsko diagnozo ter skupaj s pacientom doreče cilje fizioterapije. Naloga fizioterapevta je tudi izobraževanje oziroma svetovanje v zvezi z zdravjem ter promocija zdravja in spodbujanje zdravega življenjskega sloga. Pacientu lahko pripravi tudi terapijo, ki jo ta izvaja v lastnem domu (World Confederation for Physical Therapy 2019).

Digitalna medicina ali telemedicina je izraz, ki se uporablja za zdravstvene storitve, ki se izvajajo na daljavo preko telekomunikacijskih sredstev, kot so računalniki, telefoni, tablice, ipd. (World Confederation for Physical Therapy /International Network of Physiotherapy Regulatory Authorities 2019). Telerehabilitacijo lahko implementiramo v razna okolja (Richmond idr. 2017). Uporabljajo jo tako v bolnišnicah kot v domačem okolju. Sama telerehabilitacija omogoča pacientom dostop do specialistov ne glede na oddaljenost, omogoča vključitev v rehabilitacijo tudi osebam, ki nimajo prevoza oziroma ne morejo priti do lokacije terapije iz kakršnih koli razlogov. Z uporabo telerehabilitacije bi se lahko zmanjšale čakalne vrste, čas, ki ga oseba porabi za prevoz do terapevta in nazaj domov, s tem bi se zmanjšali tudi cenovni stroški. Stroški potovanja, bi se lahko zmanjšali tudi zdravstvenemu kadru, predvsem tistim, ki delajo na domu in se od pacienta do pacienta vozijo. Fizioterapija na daljavo je smiselna tudi, ko terapija v živo ni mogoča, v primerih, ko je predviden pregled kratek, tudi v primeru multidisciplinarne obravnave, kjer so člani tima fizično na različnih lokacijah (Armfield idr. 2014; WCPT/INPTRA 2019).

Telerehabilitacija se je pokazala kot učinkovita metoda predvsem v času epidemije SARS-COV-2. V času oddaljenosti in izolacij zaradi okužbe z virusom je bil celoten zdravstveni sistem primoran delovati na daljavo. To je znatno povečalo razvoj telerehabilitacije ter povečalo dostopnost do same terapije kljub socialni oddaljenosti. V času pandemije so bile okrnjene vse rehabilitacije, tudi za paciente, ki niso bili okuženi z virusom sars-cov-2. (Dantas idr. 2020). Fizioterapija na daljavo je pri pacientih z mišično-skeletnimi motnjami primerljiva s fizioterapijo v živo. V raziskavi, ki so jo izvedli Blanquero idr. leta 2020, pri kateri so s pomočjo uporabe aplikacije ReHand na tabličnem računalniku izvajali rehabilitacijo pri pacientih s težavami z zapestjem, dlanjo in prsti, so ugotovili, da je takšna oblika rehabilitacije učinkovitejša od rehabilitacijskega programa, ki ga predpišejo pacientom za domov (z napotki za izvajanje vaj, zapisanih na listu papirja). V povprečju so se pacienti, ki so bili deležni terapije s pomočjo aplikacije ReHand, vrnili na delo tri dni prej kot pacienti, ki so prejeli vaje na listu papirja (Blanquero idr. 2020). Mani idr. so v sistematičnem pregledu raziskav ugotovili, da je ocenjevanje bolečine, ravnotežja, obsega gibljivosti, mišične moči, otekline, izvedljivo in veljavno preko telekomunikacijskih orodij v sklopu telerehabilitacije (Mani idr. 2017).

Raziskave kažejo, da je fizioterapevtska obravnava na daljavo primerljiva z obravnavo v živo (ang. face-to-face), vendar ne dovolj kvalitetna, da bi lahko nadomestila obravnavo in oceno stanja pacienta ena na ena (ang. one-on-one) (Bernhardsson idr. 2023). Kljub številnim raziskavam, ki kažejo, da je telerehabilitacija učinkovita, je potrebno v zakup vzeti še nekaj pomembnih faktorjev. Fizioterapevt mora biti zadostno izobražen ali poučen na področju telekomunikacije, potrebuje kvalitetno telekomunikacijsko opremo, prav tako mora biti na istem področju podkovan

tudi pacient (Grona idr. 2018). Pri telerehabilitaciji pa ne moremo uporabljati fizioterapevtskih metod, kot so manualna fizioterapija, terapija s fizikalnimi agensi ter vseh tistih metod, ki zahtevajo prisotnost terapevta in obravnavo ena na ena. S pregledom literature bomo ugotavljali učinkovitost fizioterapije mišično-skeletnih poškodb na daljavo v primerjavi s fizioterapijo v živo, njeno učinkovitost pri rehabilitaciji posamičnih poškodb ter fizioterapevtske metode, ki jih lahko fizioterapevt uporablja pri telerehabilitaciji.

2 NAMEN IN CILJI

Namen raziskave je ugotoviti učinkovitost obravnave mišično-skeletnih poškodb s fizioterapijo na daljavo v primerjavi s fizioterapijo v živo.

Cilji raziskave:

- na kratko predstaviti mišičnoskeletne poškodbe, rehabilitacijo, rehabilitacijo na daljavo ter vlogo fizioterapevta in fizioterapevtske obravnave pri sami rehabilitaciji na daljavo.
- s pregledom literature zbrati podatke o učinkovitosti fizioterapije na daljavo;
- analizirati in predstaviti ugotovitve na podlagi pregleda literature izbranih člankov;
- z interpretacijo zbranih podatkov odgovoriti na raziskovalna vprašanja

Raziskovalna vprašanja

RV1: Ali je fizioterapija na daljavo učinkovita pri obravnavi mišično-skeletnih poškodb?

RV2: Katere načine evalvacije stanja lahko uporabljamo pri fizioterapiji na daljavo?

RV3: Ali je fizioterapija na daljavo primerljiva s fizioterapijo v živo pri obravnavi mišično-skeletnih poškodb?

RV4: Za katere mišično-skeletne poškodbe je fizioterapija na daljavo najprimernejša?

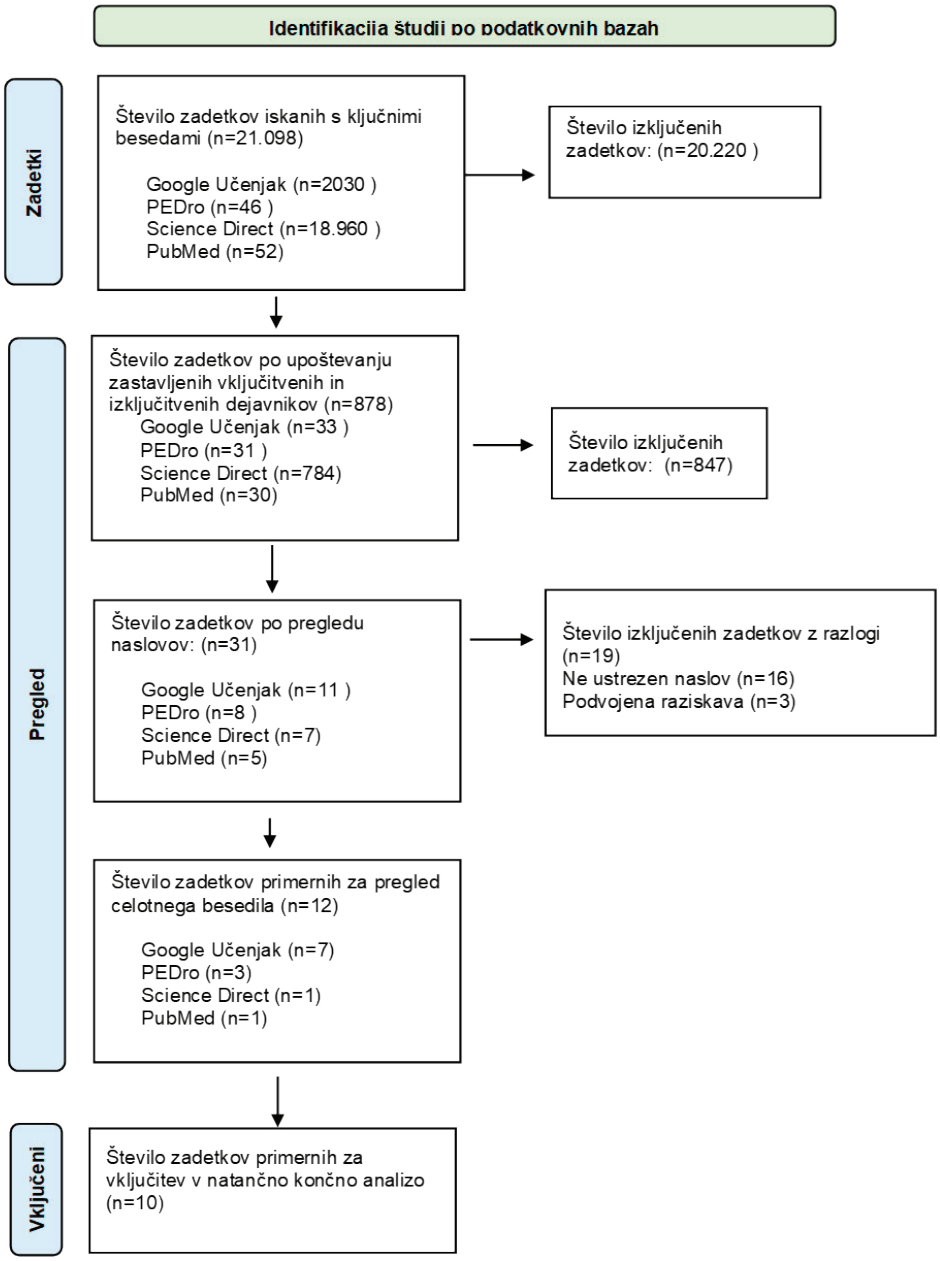
RV5: Katere so pomanjkljivosti fizioterapije na daljavo?

3 METODE

Pri pripravi raziskave smo uporabili kvalitativno metodologijo. Iskanje in analiza strokovne ter znanstvene literature sta temeljila na določenih vključitvenih in izključitvenih kriterijih. Literaturo smo iskali marca in aprila 2024 z iskalnikom Google Učenjak ter v strokovnih bazah ScienceDirect, PubMed in PEDro. V raziskavo smo vključili članke, objavljene po letu 2015, v angleškem jeziku, z oceno 5 ali več na lestvici PEDro. Izbrana literatura je obravnavala telerehabilitacijo in fizioterapijo na daljavo pri osebah z mišično-skeletnimi težavami.

Ključne besede za iskanje v slovenskem jeziku so bile: »fizioterapija na daljavo«, »telezdravje«, »telerehabilitacija«, »mišično-skeletne motnje« in »mišično-skeletne poškodbe«. V angleškem jeziku smo uporabili izraze: »remote physiotherapy«, »telehealth«, »telerehabilitation«, »musculoskeletal disorders« in »musculoskeletal injuries«. Ključne besede in besedne zveze smo kombinirali z operatorjema AND in OR, kar je omogočilo oblikovanje smiselne baze podatkov. Iskanje je bilo omejeno na znanstvene članke, ki v naslovu, abstraktu ali ključnih besedah vključujejo izraze, ki se povezujejo z naslovom raziskave. V teoretičnem delu smo uporabili metodo opisovanja, s katero smo predstavili že znane podatke in ugotovitve o izbrani tematiki. Empirični del je vključeval metode opisovanja in analiziranja, s katerimi smo izbrane podatke iz znanstvene in strokovne literature sistematično pregledali, analizirali in iskali povezave med njimi. Skupno število pridobljenih zadetkov po iskanju v naštetih podatkovnih bazah smo prikazali v diagramu PRIZMA (Slika 1). V Tabeli 1 smo tabelarično prikazali avtorje študij ter ocene študij PEDro.

Slika 1: Diagram PRIZMA



(Vir: Lastni vir 2024.)

Tabela 1: Avtorji, leto in ocene raziskav PEDro

AVTORJI IN LETO	OCENA PEDro
Pak idr. 2023	6/10
Peterson in Peolsson 2023	8/10
Withers idr. 2024	7/10
Cui idr. 2023	6/10
Mesa-Castrillon idr. 2024	5/10
Tore idr. 2023	5/10
Lambert idr. 2017	8/10
Suero-Pineda idr. 2023b	6/10
Blanquero idr. 2020b	9/10
Nuevo idr. 2023	7/10

(Vir: Lastni vir 2024.)

4 REZULTATI

Raziskave, ki smo jih vključili v raziskavo smo razdelili v dve skupini. V Tabeli 2 so prikazani avtorji, leto, tip raziskave ter namen in glavne ugotovitve raziskav v katerih so ugotavljali primerljivost med fizioterapijo na daljavo in fizioterapijo v živo. V Tabeli 3 pa raziskave, v katerih so ugotavljali primerljivosti fizioterapije na daljavo z uporabo aplikacij ter konvencionalno terapijo, pri kateri je terapevtska vadba podana z vajami na listu papirja.

Tabela 2: Tabelarični prikaz namena raziskav v katerih so ugotavljali primerljivost med fizioterapijo na daljavo in fizioterapijo v živo

Avtor in naslov raziskave	Leto	Tip raziskave	Namen raziskave in glavne ugotovitve
Pak, Sang S. idr.: Comparing Digital to Conventional Physical Therapy for Chronic Shoulder Pain	2023	Randomizirana kontrolna študija	Ugotoviti klinične izide telerehabilitacije ter rehabilitacije v živo pri osebah s kronično bolečino v ramenu.
Peterson, Gunnel in Anneli Peolsson: Efficacy of Neck-Specific Exercise With Internet Support Versus Neck-Specific Exercise at a Physiotherapy Clinic in Chronic Whiplash-Associated Disorders	2023	Multicentrična randomizirana kontrolna neinferiorna študija	Ugotoviti primerljivost specifičnih vaj za vrat s spletno podporo oziroma z nadzorom fizioterapevta v živo pri izboljšanju bolečine, kakovosti življenja, delovanja, invalidnosti ter samo-ocenjenega okrevanja pri osebah s kroničnimi posledicami pri nihajni poškodbi vratu.
Withers, Hannah G. idr.: Remotely Delivered Physiotherapy Is as Effective as Face-to-Face Physiotherapy for Musculoskeletal Conditions (REFORM)	2024	Randomizirana študija	Ugotoviti primerljivost med fizioterapijo na daljavo in fizioterapijo v živo pri obravnavi mišično-skeletnih stanj.
Cui, Di, Dora Janela, idr.: Randomized-Controlled Trial Assessing a Digital Care Program versus Conventional Physiotherapy for Chronic Low Back Pain	2023	Randomizirana kontrolna študija	Ugotoviti, ali je fizioterapija na daljavo primerljiva oziroma boljša od fizioterapije v živo pri obravnavi kronične bolečine v hrbtenici.
Mesa-Castrillon, Carlos I., idr.: Effectiveness of an eHealth-Delivered Program to Empower People With Musculoskeletal Pain in Rural Australia	2024	Randomizirana kontrolna študija	Oceniti učinkovitost trimesečne fizioterapevtske obravnave programa telesne dejavnosti na daljavo v primerjavi s konvencionalno fizioterapijo pri odraslih, ki živijo na podeželju v Avstraliji in trpijo za bolečinami v križu ali osteoartrozo kolena.

(Vir: Lastni vir 2025.)

Tabela 3: Tabelarični prikaz namena raziskav v katerih so ugotavljali primerljivosti fizioterapije na daljavo z uporabo aplikacij ter konvencionalno terapijo, pri kateri je terapevtska vadba podana z vajami na listu papirja.

Avtor in naslov raziskave	Leto	Tip raziskave	Namen raziskave in glavne ugotovitve
Tore, Nurten Gizem, Deran Oskay in Seminur Haznedaroglu: The Quality of Physiotherapy and Rehabilitation Program and the Effect of Telerehabilitation on Patients with Knee Osteoarthritis	2023	Randomizirana kontrolna študija	Primerjati učinkovitost fizioterapije na daljavo v primerjavi z vadbo, ki jo pacient izvaja doma po predhodnih navodilih fizioterapevta za osteoartrozo kolena.
Lambert, Tara E. idr.: An App with Remote Support Achieves Better Adherence to Home Exercise Programs than Paper Handouts in People with Musculoskeletal Conditions	2017	Randomizirana študija	Ugotoviti, ali se ljudje z mišično-skeletnimi stanji bolj vključujejo v vadbo in so pri izvajanju vadbe bolj redni, ko je vadba podana preko aplikacije s podporo na daljavo v primerjavi z vadbo, predpisano na listu papirja.
Suero-Pineda, Alejandro idr.: Effectiveness of a Telerehabilitation Evidence-Based Tablet App for Rehabilitation in Traumatic Bone and Soft Tissue Injuries of the Hand, Wrist, and Fingers	2023	Randomizirana kontrolirana študija	Ugotoviti, ali vaje s povratno informacijo na tabličnem računalniku zmanjšajo porabo zdravstvenih storitev in skrajšajo okrevanje v primerjavi z vajami, ki so predpisane na listu papirja, in sicer pri bolnikih s poškodbami kosti in mišično-skeletnega sistema zapestja, roke in prstov s strani javne zdravstvene službe.
Blanquero, Jesús, idr.: Feedback-Guided Exercises Performed on a Tablet Touchscreen Improve Return to Work, Function, Strength and Healthcare Usage More than an Exercise Program Prescribed on Paper for People with Wrist, Hand or Finger Injuries	2020	Randomizirana študija	Ugotoviti, ali se pri osebah z mišično-skeletnimi poškodbami zapestja, dlani in prstov zmanjša uporaba zdravstvenih storitev, izboljša klinično okrevanje in skrajša bolniški stalež v primerjavi z osebami, ki vadbo izvajajo preko programa vadbe, predpisanega na listu papirja.
Nuevo, Montse, idr.: Telerehabilitation Following Fast-Track Total Knee Arthroplasty Is Effective and Safe: A Randomized Controlled Trial with the ReHub® Platform	2023	Randomizirana klinična študija	Dokazati učinkovitost in varnost interaktivnega rehabilitacijskega sistema ReHub za vodenje in zagotavljanje povratnih informacij med vadbo v postoperativnem obdobju programa hitrega okrevanja po totalni artroplastiki kolena.

(Vir: Lastni vir 2024.)

Primarni izidi:

Fizioterapija na daljavo je bila pri večini preiskovancev enako učinkovita kot fizioterapija v živo.

V digitalnih skupinah so terapevtsko vadbo kombinirali z izobraževanjem in kognitivno vedenjsko terapijo, kar je izboljšalo zavzetost in zmanjšalo osip preiskovancev. Uporaba senzorjev za detekcijo gibanja (npr. Pak idr. 2023, Cui idr. 2023) in aplikacij, kot sta Physitrack in Physi App, je omogočila individualizirane programe ter varno izvajanje vadbe. Nekatere študije (Pak idr. 2023, Cui idr. 2023, Mesa-Castrillon idr. 2024) so izvedle celotno terapijo na daljavo, medtem ko sta Peterson in Peolsson ter Withers omogočila le delno prisotnost fizioterapevta v živo. Za evalvacijo so avtorji uporabili kombinacijo specifičnih vprašalnikov in lestvic, kot so PSFS, QuickDASH, ODI in WOMAC, za merjenje funkcionalnosti, invalidnosti, bolečine ter kakovosti življenja. V vseh raziskavah je bila terapevtska vadba glavna metoda zdravljenja. Vključevanje pacientov v digitalne programe je bilo učinkovito pri prilagajanju vadbe njihovim potrebam, kar je omogočilo višjo raven sodelovanja.

Sekundarni izidi:

Poleg funkcionalnosti in invalidnosti so raziskave merile bolečino (NRS, VAS), psihično stanje (GAD-7, PAQ-9) in kakovost življenja (EQ-5D, SF-12). Strah pred gibanjem in poškodbo so ocenjevali s testi TKS in FABQ-PA. Digitalne skupine so bile pogosteje in bolj dosledno prisotne pri vadbi, z nižjim osipom preiskovancev. V nasprotju s tem so bile v nekaterih raziskavah bolj zavzete osebe v skupinah s konvencionalno fizioterapijo. Raziskave so pokazale, da je fizioterapija na daljavo učinkovita pri obravnavi mišično skeletnih poškodb.

5 RAZPRAVA

Namen raziskave je bil ugotavljati, kakšne so možnosti fizioterapevtske obravnave na daljavo pri mišično-skeletnih poškodbah. Zanimalo nas je, ali je fizioterapija na daljavo učinkovita pri rehabilitaciji mišično-skeletnih poškodb, katere načine evalvacije stanja lahko uporabimo pri fizioterapiji na daljavo, ali se lahko fizioterapija na daljavo primerja s fizioterapijo v živo pri obravnavi mišično-skeletnih poškodb, za katere mišično skeletne poškodbe je ta oblika rehabilitacije primerna in katere so pomanjkljivosti fizioterapije na daljavo.

V raziskavi smo ugotovili, da je fizioterapija na daljavo učinkovita pri obravnavi mišično skeletnih poškodb. Učinkovita je tudi kot komplementarna terapija ob terapiji v živo, kar zmanjša število obiskov pri specialistih in nudi podporo pacientom v udobju njihovega doma. Avtorji so ugotovili, da je fizioterapija na daljavo enako učinkovita kot fizioterapija v živo (Pak idr. 2023; Cui idr. 2023; Withers idr. 2024) ter da je fizioterapija na daljavo enako učinkovita kot fizioterapija v fizioterapevtski kliniki (Peterson in Peolsson 2023). V raziskavi, ki so jo izvedli Tore idr. (2023), so pri postavljeni vrednosti p = 0,05 vse izmerjene spremenljivke pokazale, da je fizioterapija na daljavo s pomočjo aplikacije učinkovitejša kot fizioterapevtska vadba, ki jo pacient izvaja sam v domačem okolju po navodilih fizioterapevta, kjer vaje doma izvaja s pomočjo opisa vaj na listu papirja (Tore idr. 2023). Pri izmerjenih spremenljivkah vezanih na bolečino, kvaliteto življenja, KOOS, NRD in 30 CTS je bil $p < 0,001$. Ostale izmerjene spremenljivke pa so dosegle raven pomembnosti $p \leq 0,04$, kar dokazuje, da je fizioterapija na daljavo učinkovitejša od fizioterapevtske vadbe, ki so jo izvajali pacienti vključeni v kontrolno skupino. V raziskavi avtorja Blanquero idr. (2020) so se preiskovanci vključeni v digitalni program na delo vrnili kar 28 dni pred preiskovanci vključenimi v kontrolno skupino, kar nam pove, da je bila v tem primeru digitalna fizioterapija učinkovitejša kot konvencionalna oblika terapije. Nuevo idr. so ugotovili, da je fizioterapija na daljavo z uporabo aplikacije ReHub pri osebah po totalni artroplastiki kolena učinkovitejša v primerjavi z vadbo podano na listu papirja. Fizioterapija na daljavo se je v študijah avtorjev Suero-Pineda idr. (2023) izkazala kot učinkovitejša tudi s stroškovnega vidika. V raziskavah ni bilo ugotovljenih pomembnejših razlik med obema oblikama terapije. Kljub različnim pristopom in meritvam, ki so jih avtorji vključenih študij uporabljali, smo ugotovili, da je povprečna učinkovitost rehabilitacije na daljavo v primerjavi s fizioterapijo v živo pri meritvah primarnih izidov pri nastavljenem intervalu zaupanja 95% in p = 0,05 znašala približno 1,2 (95% IZ; -13,5 do 9,8; p = 0,4) (Pak idr. 2023; Cui idr. 2023; Peterson in Peolsson 2023; Mesa-Castrillon idr. 2024).

Za evalvacijo stanja so avtorji člankov vključenih v raziskavo uporabljali vprašalnike. Nekateri od uporabljenih vprašalnikov za merjenje funkcije ali invalidnosti so: PSFS, QuickDASH, LLFDI, RMDQ in drugi. Najpogostejši vprašalniki za ugotavljanje bolečine pri pacientih so bili VAS lestvica in NRS ter njene različice. Avtorji, ki so raziskovali na področju patologij oziroma poškodb posameznih delov telesa, so uporabljali patologijam prilagojene teste kot so: NDI, KOOS, QuickDASH, WOMAC in WDQ. Avtorji, ki so v raziskavo vključili paciente s poškodbami rok, so uporabljali QuickDASH test (Suero-Pineda idr. 2023; Blanquero idr. 2020b; Pak idr. 2023).

Raziskave potrjujejo, da je fizioterapija na daljavo pri obravnavi mišično-skeletnih poškodb primerljiva s fizioterapijo v živo. Cui idr. (2023) so ugotovili, da med obema pristopoma ni statistično pomembnih razlik pri merjenju stopnje bolečine osem tednov po intervenciji (p=0,913; 95% IZ: -0,76 do 0,84). Mesa-Castrillon idr. (2024) so dokazali, da fizioterapija na daljavo pripomore k izboljšanju funkcije, kar so merili s PSFS vprašalnikom. Statistično pomembne razlike so bile zabeležene tri (3,6 točke; p=0,002) in šest mesecev po intervenciji (3,5 točke; p=0,004). Poleg tega fizioterapija na daljavo zmanjšuje bolečino in izboljšuje kakovost življenja, kar so potrdile raziskave več avtorjev (Lambert idr. 2017; Suero-Pineda idr. 2023).

Študije potrjujejo, da je terapija na daljavo učinkovita pri obravnavi različnih stanj, vključno s kronično bolečino v ledvenem in cervikalnem delu hrbtenice, osteoartrozo kolen, poškodbami ramena, zapestja, dlani in prstov, ter po totalni artroplastiki kolena. Peterson in Peolsson (2023) sta na primer pri bolnikih z nihajno poškodbo vratu opazila zmerno do veliko zmanjšanje rezultatov testa NDI tri (-9,1 točke) in petnajst mesecev po intervenciji (-10,1 točke; velikost učinka 1,33).

Telefonski klici, besedilna sporočila in aplikacije, kot je ReHand, dodatno povečujejo zavzetost pacientov, kar vodi v hitrejšo rehabilitacijo. Lambert idr. (2017) so dokazali, da so pacienti, ki so upora-

bljali aplikacijo, dosegli boljše rezultate kot kontrolne skupine. ReHand je zmanjšal število obiskov pri zdravnikih (za dva posveta; p<0,001) in fizioterapevtih (za devet posvetov; p=0,02) ter izboljšal funkcijo in pincetni prijem pri poškodbah zgornjih udov (Blanquero idr. 2020; Suero-Pineda idr. 2023).

Kljub številnim prednostim ima fizioterapija na daljavo tudi pomanjkljivosti. Osebe brez dostopa do telekomunikacijskih naprav ali internetne povezave pogosto niso vključene v raziskave. Poleg tega so terapije ranljive na tehnične težave, omejen je osebni stik med fizioterapevtom in pacientom, kar vpliva na uporabo manualnih tehnik in neposreden fizični nadzor, ključen za varnost pacientov (Lambert idr. 2017; Blanquero idr. 2020; Cui idr. 2023).

Analiza raziskav je pokazala, da je fizioterapija na daljavo v 80% primerljiva s fizioterapijo v živo, v 20% pa se izkaže za superiorno (Blanquero idr. 2020b; Lambert idr. 2017). Uporablja se lahko kot samostojna terapija ali kot dopolnitev fizioterapije v živo, saj je pri obravnavi mišično-skeletnih poškodb dokazano enako učinkovita, kar potrjujejo ugotovitve Withers idr. (2024), ki so beležili povprečno razliko v funkcionalni lestvici šest tednov po intervenciji (2,7 točke; 95% IZ: -3,5 do 8,8).

Pomanjkljivosti fizioterapije na daljavo, ki jih lahko razberemo iz pregledanih študij vključenih v raziskavo, so predvsem tiste pomanjkljivosti, ki so povezane s telekomunikacijskimi pripomočki. V veliko raziskavah so bili preiskovanci avtomatsko izključeni iz raziskav, če niso imeli tabličnega računalnika, pametnega telefona, računalnika, dostopa do interneta ali pa niso bili vešči uporabe telekomunikacijskih pripomočkov. Ena od slabosti je tudi, da terapije ne delujejo nemoteno, če pride do kakršnih koli tehničnih težav. Pomanjkljivost fizioterapije na daljavo je tudi dejstvo, da je omejen osebni stik in fizični nadzor pacienta. Kljub temu, da se pred fizioterapijo na daljavo upošteva vse potrebno za izogibanjem padcem, je možnost za padce večja, saj pacient ni v kontroliranem okolju ter ni pod nadzorom fizične osebe, ki mu lahko v primeru padca nemudoma priskoči na pomoč. Fizioterapevt je pri fizioterapevtski obravnavi na daljavo omejen tudi iz vidika uporabe fizioterapevtskih tehnik, kot so uporaba fizikalnih agensov, manualna terapija in druge terapije, ki zahtevajo, da sta tako terapevt kot pacient v istem prostoru (Lambert idr. 2017; Blanquero idr. 2020; Pak idr. 2023; Peterson in Peolsson 2023; Cui idr. 2023; Nuevo idr. 2023; Suero-Pineda idr. 2023b; Tore idr. 2023; Withers idr. 2024; Mesa-Castrillon idr. 2024).

6 ZAKLJUČEK

Socialna omrežja in telekomunikacijska tehnologija, ki je v stalnem razvoju, nam omogočajo številne kanale in načine, s pomočjo katerih lahko ljudi ozaveščamo o pomenu zdravega načina življenja, skrbi zase, pomenu gibanja ter drugih poučnih tem, ki bi lahko ljudi usmerjale v boljšo skrb zase. Aplikacije, ki so omenjene v diplomskem delu, so čudovit primer, kako lahko z digitalizacijo vstopimo v domove ljudi in jim na ta način pomagamo pri gibanju, pravilni izvedbi gibanja, jih spremljamo, jim nudimo oporo, jih spodbujamo in s tem povečamo možnosti za kvalitetno okrevanje. Telekomunikacijske naprave in načini povezljivosti s telekomunikacijskimi orodji nam omogočajo interaktivno rehabilitacijo, kar lahko pritegne večje število ljudi k opravljanju same vadbe, saj imajo med njo občutek, da ne izvajajo terapevtske vadbe, temveč, da se zabavajo. Telekomunikacijska orodja lahko s svojim beleženjem aktivnosti pozitivno in spodbujajoče vplivajo na posameznika in ga s tem spodbujajo za nadaljevanje rehabilitacijskega programa ter ga vodijo na poti do hitrejšega okrevanja. Telerehabilitacija je s strani pacientov dobro sprejeta; pritegne jih k rednemu izvajanju terapije tudi v domačem okolju brez nadzora fizioterapevta. Vadba in monitoring pacientov na daljavo zmanjšujeta stroške rehabilitacije in tudi število obiskov v ambulantah. S preventivnim delovanjem preko terapevtskih vadb, dostavljenih preko telekomunikacijskih sistemov in ozaveščanjem ljudi, kako pomemben je aktivni življenjski slog za ohranjanje zdravega mišično-skeletnega sistema ter kako pomembna je vadba, bi se incidenca mišično-skeletnih poškodb mogoče zmanjšala.

V raziskavi smo ugotovili, da je fizioterapija na daljavo primeren način obravnave mišično skeletnih poškodb, da je ta oblika terapije učinkovita in primerljiva s konvencionalno fizioterapijo. Kljub številnim prednostim se fizioterapija na daljavo sooča z nekaj pomanjkljivostmi kot so osebni pristop, človeški stik in omejen fizični nadzor. V raziskavi ni podatka o tem, koliko je fizioterapija na daljavo primerljiva s celostno fizioterapijo, ki jo nudijo fizioterapevti z vsem svojim znanjem fizikalne terapije, manualnih tehnik ter drugih tehnik, ki zahtevajo stik ena na ena.

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1.09 Objavljeni strokovni prispevek na konferenci
Published professional conference contribution

ENTREPRENEURSHIP AND THE USE OF THE BUSINESS MODEL CANVAS IN DECIDING ON A PRIVATE PHYSIOTHERAPY PRACTICE

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ABSTRACT

Creating a quality business model plays a key role in the process of planning a business, as it helps determine whether an idea is strong enough to be transformed into a market opportunity. The purpose of this study was to present entrepreneurship, business models, entrepreneurship

in healthcare, and the laws and organization of healthcare in Slovenia. We used a descriptive method with literature which we sourced from different international databases such as PubMed, PEDro, ScienceDirect and an analysis of Slovenian healthcare laws. The results showed that the Canvas business model is an effective tool for planning the establishment of a private healthcare business. It offers a comprehensive approach, encouraging entrepreneurs to reflect on key aspects such as costs, customers, revenue streams, and value propositions. This study aims to present an effective tool for planning and evaluating the feasibility of creating a private healthcare business in the field of physiotherapy. It also outlines the requirements, procedures, and challenges involved in aligning with the strict regulations that may arise during the planning process for establishing such a business.

Keywords: *Entrepreneurship, Business model, Canvas Business Model, Laws and Healthcare*

1 INTRODUCTION

Entrepreneurship today is understood as more than just the act of starting a business. It is a process in which an individual identifies an opportunity, develops it into a concrete idea, and attempts to create added value on the market. The key elements of this process include creativity, a willingness to take risks, and the ability to adapt to change (Hisrich et al. 2017).

In recent years, entrepreneurship has increasingly emerged in sectors where it was not traditionally associated—such as healthcare. In this context, it is seen as the search for new solutions that make healthcare services better, more efficient, and more accessible (Giones et al. 2021). This suggests that physiotherapists, by adopting an entrepreneurial mindset, can significantly contribute to improving patient care—by introducing new services, tailoring approaches to users' needs, and creating more user-friendly environments (Muwafak et al. 2021).

Due to the complexity of managing a private physiotherapy practice, the question arises: how can such a business be planned to ensure both commercial success and compliance with healthcare standards? One of the key tools in this process is the Business Model Canvas, which enables a clear and structured overview of all essential aspects of business planning—from defining customer value to analyzing cost and revenue structures (Osterwalder and Pigneur 2010).

Physiotherapists play a vital role in improving people's quality of life, influencing not only physical but also psychosocial well-being. They are involved in various stages of healthcare—from prevention and health promotion to treatment, rehabilitation, and reintegration into everyday life (World Physiotherapy 2023). Given their broad scope of practice and the growing demand for physiotherapy services, there is increasing potential for offering such services in the private sector. As noted by Koranteng et al. (2023), physiotherapy has a valuable complementary role across different medical specialties, indicating room for the development of new, more tailored approaches. This represents an opportunity for physiotherapists considering an independent entrepreneurial path and looking for suitable tools to plan their own practice.

The Business Model Canvas has proven to be an effective tool for planning and implementing entrepreneurial projects in healthcare, particularly in physiotherapy. Falkenberg and Sorvali (2023) found that physiotherapists often approach entrepreneurship from a clinical perspective, and that the Canvas model helps them better understand business aspects that are not typically addressed in their formal education. It also enables structured business planning, a deeper understanding of the market, and more effective adaptation of services to patient needs.

2 PURPOSE AND GOALS

The purpose of this study is to present an entrepreneurial approach and the use of the Business Model Canvas as a tool for effectively planning a private physiotherapy practice in Slovenia.

The focus is on understanding the key elements of the business model, the legal framework, and the specific challenges and opportunities involved in establishing a private healthcare practice.

The objectives of the study are to present the fundamental concepts of entrepreneurship; to describe the particularities of entrepreneurship in healthcare, with a focus on physiotherapy; to analyze the legal and organizational framework for running a private healthcare business in Slovenia; to assess the usefulness of the Business Model Canvas as a planning tool for private physiotherapy practices; and to identify the key steps, challenges, and requirements involved in setting up such a practice.

3 METHODS

The study is based on a descriptive research approach, with the aim of describing and analyzing the Business Model Canvas as a suitable tool for planning a private physiotherapy practice. A qualitative method of literature review was applied, focusing on contemporary sources related to healthcare entrepreneurship, business models, and the organization of physiotherapy services.

The literature was sourced from databases such as PubMed, PEDro, and ScienceDirect, as well as relevant Slovenian legal and regulatory documents. We included scientific articles, expert publications, books, and reliable online sources. The selection criteria required that sources be directly related to healthcare-adapted business models, relevant to physiotherapy and private practice, up-to-date, and professionally or scientifically credible.

Based on our own market analysis, we developed an example of a Business Model Canvas tailored to physiotherapy practice. As the study does not involve the collection of personal data or the participation of individuals, ethical approval was not required.

4 RESULTS

Entrepreneurship can be defined as the study of how to create, evaluate and exploit opportunities, with whom and to what effect. It represents a form of innovation that adds new value-creating capacity to existing resources (Shane and Venkataraman 2000).

In a broader sense, entrepreneurship could be defined as an effort to improve business by finding new and different ways to compete, which can be achieved by developing technology, discovering new knowledge, finding new services that are better, of higher quality and more efficient than existing ones, and providing greater consumer satisfaction (Manurung and Anggiat 2021, 1089).

The development of entrepreneurship in the healthcare sector in Slovenia began after the Second World War, as the war increased the need for health care and nurses and other health workers became entrepreneurs (Kresal 2006).

Physiotherapists were given the opportunity to practise their profession in private practice after 2004, when the National Assembly of the Republic of Slovenia adopted the Law on Amendments and Additions to the Law on Health Care Activity (Nered 2013). This legislation specified that the Minister of Health is responsible for publishing a list of healthcare professions and specializations for which professionals must be registered and hold a valid license in order to work independently (ZZDej).

Entrepreneurship in health care has increased in recent years, which means that health workers need to be trained in entrepreneurial skills (Manurung and Anggiat 2021). Because of the high entrepreneurial risk, it is very important which health services a private entrepreneur decides to provide. The risk is lower if private entrepreneurs provide services that are in sustained demand and do not require expensive medical equipment and the help of other health professionals. Curative activity is more attractive than preventive activity, as the effects are poorly recognised from people's point of view and the time component between service and outcome is often hidden (Silvaši 2003). Currently, trends in healthcare are on the rise, especially in the areas of telemedicine, remote monitoring and home health services (Lumar University 2023).

Health care in Slovenia is regulated by the Health Care Act (Zakon o zdravstveni dejavnosti), which provides for the content and performance of health care activities, the public health service, and the association of health care organisations and health care professionals into chambers and associations (ZZDej). Health care in Slovenia is provided at three levels. These are primary, secondary and tertiary. The public health service network at the primary level is determined by the municipality or city, and at the secondary and tertiary levels by the Republic of Slovenia (Petrič and Žerdin 2013).

The public health service comprises health services that are wholly or partly financed from public funds, mainly from compulsory health insurance. The providers of the public health service are public health institutions, which include health centres, hospitals, clinics and pharmacies, legal entities, which include private health institutions and companies with a concession, and natural persons or private individuals with or without a concession and without a contract with the Health Insurance Fund of Slovenia (Zavod za zdravstveno zavarovanje Slovenije). They set their own prices, and patients are required to pay for the services in full themselves (Ministrstvo za zdravje 2023).

All health care providers, public or private, at primary, secondary or tertiary level, must obtain a health care licence or a decision on registration in the register of private health care providers from the Ministry responsible for health (izvajalci zdravstvene dejavnosti b.d.).

In the contract year 1994, the ZZZS contracted 535 public and private institutions (Gregor 2005), and in 2023, 1,612 health service providers, of which 1,411 were private concessionaires and 201 public health institutions (ZZZS).

The legal forms in which private healthcare activities are most commonly carried out are the sole proprietorship (s.p.), the private healthcare professional or institution and the limited liability company (d.o.o.) (Zdraviliška zbornica Slovenija b.d.).

Private health workers and associates are natural persons who have obtained a licence from the Ministry of Health to carry out health care activities (ZZDej, Act 35). They can work independently after completing an apprenticeship and after passing a professional examination. (ZZDej, Act 64). Upon fulfilment of the conditions set out in Act 3a of ZZDej, a private health worker is issued with a permit to carry out health care activity in the form of a decision on registration in the register of private health workers kept by the Ministry responsible for health care, which contains information on the worker, his/her education, the type of activity he/she carries out, the seat and scope of the activity, and the date of commencement of the activity. If a private health worker infringes the regulations referred to in Act 8 of the ZZDej, his/her licence to practise shall be revoked and he/she shall be removed from the register of private health workers.

,'Physiotherapy practitioners may carry out physiotherapy activities independently if they are registered in the register and hold a valid licence'' (Pravilnik o registru in licencah izvajalcev fizioterapevtske dejavnosti).

Pursuant to Act 11 of the Regulation on the issuance of an expert opinion for the practice of private health care (pravilnik o izdaji strokovnega mnenja za opravljanje zasebne zdravstvene dejavnosti), a provider may practice private health care in the field of physiotherapy and obtain an opinion if he or she meets the following conditions: the required education in accordance with Acts 62, 63 and 64 ZZDej, and the conditions for the issuance of an expert opinion for the practice of private health care.

Specialised physiotherapy treatments are defined in the contract between the provider and the Institute, if the physiotherapist is registered in the List of providers of specialised physiotherapy treatments (seznam izvajalcev za specialne fizioterapevtske obravnave) (Uradni list Republike Slovenije 2024, 904).

,'The public service in the health sector may be performed by domestic and foreign legal and natural persons on the basis of a concession, provided that they meet the conditions laid down in this act'' (ZZDej, Act 41).

,'A concession under this act is a power of attorney granted to a natural or legal person to perform a public health service. The concessionaire shall carry out the health care activity under the concession in his own name and on his own account on the basis of the authorisation of the concessionaire'' (ZZDej, Act 42).

Act 42 of the ZZDej also states that a concession shall be granted if the concessionaire determines that the public health institution cannot provide the health care activity to the extent provided for in the public health service network or if the public health institution cannot provide the necessary access to health care services.

In order to obtain and exercise a concession, a private health professional must fulfil certain conditions (ZZDej, Act 44):

- has authorization to perform healthcare activities
- has a full-time responsible person employed for the type of health activity, except that, if the practitioner is a sole practitioner, he or she may be employed on a part-time basis
- it has an adequate number of qualified health professionals who meet the conditions and will provide the services covered by the concession
- has concluded a contract with a public health institution on the extent and nature of the cooperation for the purposes of the provision of continuing healthcare

- has liability insurance in accordance with the law
- has not had its concession revoked in the last five years
- is not the subject of proceedings before the authorities of the competent chamber or professional association for professional misconduct
- there are no grounds for exclusion applicable to tenderers in public procurement procedures

A concession is announced through a public call for applications and, if the conditions are met, is granted for a period of 15 years from the start of providing healthcare services. Before the end of this period, the granting authority must assess the implementation of the program. If the conditions are still being met, the concession can be extended for an additional 15 years (ZZDej, Act 43).

A concession for primary-level healthcare services is granted by the municipality, with the consent of the Ministry of Health and the Health Insurance Institute of Slovenia (ZZZS). For secondary-level services, the concession is granted by the Government of the Republic of Slovenia, subject to the prior consent of the ZZZS (ZZDej, Act 44a).

According to Act 44.f of the ZZDej, the concession contract regulates the mutual relationship between the parties, specifying the type and scope of healthcare programs or services, the area and location of service provision, the responsible service provider, the financing model, working hours, the start and duration of the concession, grounds and conditions for contract termination, notice periods, mutual rights and obligations, the conditions the concessionaire must meet, reporting obligations, contractual penalties for non-performance, the obligation to participate in the national healthcare information system, etc.

When planning a new business, the organisation's business model is one of the most important segments of strategic planning for achieving long-term goals (Stanimirović and Vintar 2012). Joan Magretta (2002) states that a business model is a story that explains how companies operate. It is a document or strategy that describes how a company or organisation delivers value to its customers (Joubert 2020). Business models are effective guides for discovering how to create value, identify consumer needs, take advantage of external opportunities, and determine what resources are needed, how to make money, and what are the short, medium and long-term goals (Murray and Scuotto 2016). Business models are also effective guides for discovering how to create value, identify consumer needs, take advantage of external opportunities, and identify what resources are needed, how to make money, and what are the short, medium and long-term goals. According to Ovans (2015), a business model has two key parts: the first part includes all the activities related to making something: planning, purchasing raw materials, production, and so on. The second part includes all the activities related to selling something: finding and reaching customers, closing the sale, distributing the product or providing the service. Magretta (2002) also points out that the business model is a competitive strategy that explains how we can outperform our competitors.

This can be achieved either by offering a better business model or by applying the same model to a different market. There are eight commonly used business models: subscription, low-cost, retail, advertising, franchising, brokerage, services, and leasing. These models are often divided into specific patterns, with some of the most recognized ones described below (Price 2022):

- Razor and blade model (e.g., Nespresso) involves selling the core product at a low price while generating profit from the consumables sold at high margins. It is designed to encourage recurring consumption. Examples include Gillette (razor handles/blades), Nespresso (coffee machines/capsules), and printers/ink cartridges (CIMTI 2020).
- Freemium service refers to offering a basic version of a service for free while charging for premium features or upgrades. In this case, the revenue comes from subscriptions. Examples include Spotify, Skype, LinkedIn, and YouTube (Segal 2024).
- Reverse razor and blade is the opposite model—where the services (such as music or e-books) are sold cheaply or even given away, while the required hardware (e.g., iPhone, Kindle) is expensive. Another example is when a high-priced product is sold, and subsequent upgrades or add-ons are monetized separately (Price 2022).

- Affiliate marketing is an advertising model where companies pay third parties a commission for generating traffic or sales leads. It encourages businesses to find innovative ways to promote their products. Though it existed before the internet, affiliate marketing has become a billion-dollar industry in the digital age. The model was popularized by Amazon, where bloggers, influencers, and websites post product links and receive a fee for every view or sale generated. It is essentially performance-based compensation: the more purchases or visits, the higher the revenue (Investopedia 2024).

If you asked five different people what a business model is, you'd likely get five slightly different answers. However, they would all point to a common understanding—that a business model is a framework that describes how an organization creates, delivers, and captures value. This is because people working in business often understand the concept intuitively (Strategyzer 2024).

The Business Model Canvas was developed by entrepreneur Alexander Osterwalder and professor Yves Pigneur and is currently one of the most widely used business models (Bouronikos 2022). They named it a "canvas" because it is laid out on a single page and provides a clear visual overview of the entire model. It is a visual tool that includes elements describing a company's value proposition, infrastructure, customers, and finances (Strategyzer 2024).

According to Osterwalder, a business model is a structured way to present assumptions—not only about key resources and activities within the value chain, but also about the value proposition, customer relationships, distribution channels, customer segments, cost structure, and revenue streams. The canvas serves as a tool to check for any blind spots and to compare one's business model with others (Osterwalder and Pigneur 2010).

The Business Model Canvas offers a comprehensive approach that encourages entrepreneurs to focus more closely on their customers while also providing a clearer overview of costs and revenues. It allows business owners to experiment with their operations on a daily basis, relying on a trial-and-error approach (Murray and Scuotto 2016). It was the first in a line of practical, simple, and visual tools that have transformed how companies innovate. Today, it is considered a key resource for innovators and entrepreneurs (Strategyzer 2024).

The canvas is structured around four core areas of a business: desirability (whether customers want the service), viability (how value is captured financially), feasibility (how the service is delivered), and adaptability (whether the idea can survive and evolve in a changing environment). These areas are broken down into nine building blocks (Strategyzer 2024).

The Business Model Canvas is well-suited to the specific characteristics of the healthcare sector, where innovation is often focused on improving quality of life and extending life expectancy (CIMTI 2020).

In this project, we decided, based on an extensive review of the literature, to conduct our own market analysis. The results served as the foundation for developing a business model for our idea of establishing a private physiotherapy practice.

We used this example to define the key components of the Business Model Canvas for private physiotherapy services:

The customer segment refers to the specific groups of people or organizations a company aims to reach and serve with its services and it is the heart of every business model. We begin by asking: For whom are we creating value? Who are our most important customers? Our physiotherapy practice is focused on women's health and pelvic floor physiotherapy, so our primary customer segment would be women seeking specialized care during pregnancy, postpartum recovery, following oncological surgeries, and throughout or after menopause. This also includes women experiencing issues related to the pelvic area, chronic or acute musculoskeletal pain, or those who are looking for guidance toward a healthier lifestyle and safe, tailored physical activity in a space where they feel safe, supported, and respected.

The value proposition defines the value we offer, the problems we solve, and why customers would choose us over other providers. Our company will offer high-quality, effective, professional, and holistic physiotherapy care tailored to the individual needs of women facing various physical and emotional challenges. We will ensure fast access to one-on-one sessions, focusing on

privacy and creating a trusting atmosphere. The facilities will be clean, welcoming, and aesthetically designed, including spaces for changing, breastfeeding, and infant care. Survey results also indicated the potential value of offering a limited number of home visit sessions. We plan to implement a communication system using SMS, email, and other digital channels to keep clients informed and engaged. Although competition exists in all areas we aim to cover, no provider in the Dolenjska region currently offers comprehensive, specialized physiotherapy services focused exclusively on women. This would represent our key competitive advantage.

Distribution channels describe how a business communicates with its customer segments to deliver its value proposition. Our premises will be located in the center of Novo mesto, with accessible parking and wheelchair-friendly entry. We will have a website providing all essential information about our services, access, pricing, and contact details.

We will also be active on the company's Instagram and TikTok profiles, where we will regularly share high-quality photo and video content focused on women's health. These platforms will be used to promote ideas for physical activity, short exercise clips, and updates about new programs and service offerings. Our main communication with clients will take place via email, Instagram, Facebook, and TikTok, as the survey results showed these are the most commonly used channels among our target group. Additional marketing tools will include magazine articles, client referrals, and collaborations with an advertising agency.

Customer relationships refer to the types of interactions a company establishes with its various customer segments and significantly affect the overall user experience. Our approach to client relationships will be personal, professional, discreet, and relaxed. We aim to build a community, including a private Facebook group where we would remain actively engaged.

We will offer appointment reminders via SMS, maintain a mailing list for regular communication, and provide the option of online consultations or discussions via Zoom. At the end of treatment or the calendar year, clients will be invited to complete a feedback survey.

Revenue streams represent the income generated by the business and help it understand the value that customers are willing to pay for its services. This includes the cost of goods and labor (salaries). We will calculate how many treatment sessions per month are needed to achieve the expected average monthly income. Based on this, we will develop a pricing structure for our services. The estimated revenue for the first year of operation is €61,125, with projections for growth in the following years.

Key resources refer to the essential assets required to deliver the value proposition, maintain distribution channels, and build customer relationships. We estimated our initial investment to be between €25,000 and €30,000. This includes the interior furnishings of the clinic, physiotherapy equipment, computer and office supplies, hygiene materials, branding expenses, and the purchase of therapeutic devices.

Key activities are the critical tasks that a business must perform to successfully deliver and distribute its value. Our main activities will include individual specialized physiotherapy sessions, individual and group exercise programs, pain relief therapy, educational lectures and support groups, neuro physiotherapy for children, and home visit services.

Partnerships can help increase the clinic's performance, improve service quality, expand the network of potential clients, and contribute to better treatment outcomes. Our key partners will include medical equipment suppliers, healthcare institutions, commercial landlords, a marketing agency, and an accounting firm. Over time, we also plan to include a neuro physiotherapist specializing in treatments for infants and children.

The cost structure outlines the most important expenses associated with the business model. Our overhead costs would include monthly expenses such as employee salaries, rent for business premises, insurance, and accounting services. We would also cover monthly utility bills, including water, electricity, heating, phone, and internet. In addition, we would require software and technology to manage appointment scheduling, monitor patient progress, send messages, communicate with clients, and issue invoices. Operational costs would include ongoing staff training and professional development, maintenance of equipment and devices, consumable hygiene and office supplies, and marketing services.

5 DISCUSSION

Based on the review of literature and the analysis of the Business Model Canvas, we found that it is a highly appropriate tool for planning a private physiotherapy practice. The model offers a comprehensive and structured overview of key business elements, such as customer segments, value propositions, key activities, revenue streams, cost structure, customer relationships, distribution channels, key partners, and key resources. Based on our market research, we developed an example business model tailored to physiotherapy practice in Slovenia. This case illustrates how physiotherapists can take a systematic approach to planning private services. A central strength of the Canvas model is its focus on the needs of the end user—an especially important principle in healthcare, where trust, personalization, and quality of care are essential. Despite its usefulness, the model remains underused among healthcare professionals in Slovenia. Many are clinically skilled but lack business knowledge, often due to limited exposure to entrepreneurship in their education or uncertainty about administrative procedures. Falkenberg and Sorvali (2023) highlight a similar gap, showing that physiotherapists approach entrepreneurship mainly from a clinical perspective. The Canvas model helps bridge this by offering a simple and visual structure for developing business thinking and planning. This study was conceptual and descriptive in nature and does not include empirical testing. Future research could incorporate case studies or interviews with healthcare professionals who have implemented the Canvas model in real practice to gain deeper insight into its practical value and challenges. We recommend that the Business Model Canvas be integrated into healthcare and physiotherapy education, either as part of the regular curriculum or as elective content. Doing so would support the development of entrepreneurial thinking, improve confidence among future practitioners, and ultimately contribute to more accessible, patient-centered, and sustainable healthcare services.

6 CONCLUSION

This study has shown that the Business Model Canvas is a highly suitable tool for physiotherapists planning to establish a private practice. Its key advantage lies in its user-centered design, with the customer segment and value proposition forming the core of the model. In healthcare, where the relationship between provider and patient is especially sensitive and valuable, this approach is even more important. Despite its benefits, the Canvas model remains underused in the Slovenian healthcare context. Among physiotherapists and other healthcare professionals considering private practice, there is often a strong technical and clinical focus, while the business aspect is overlooked. This may be due to a lack of entrepreneurial education within healthcare study programs or fear of bureaucracy and the perceived complexity of entering the private sector. Studies such as Falkenberg and Sorvali (2023) confirm that the Canvas model provides a structured approach to business development, greater transparency of costs and revenues, better market understanding, and flexibility in adapting to change. All of these are essential for the long-term sustainability of private healthcare services. A limitation of this study is its descriptive nature, without empirical testing among physiotherapists in practice. Future research should include interviews or surveys with healthcare professionals who have implemented the Canvas model. Based on our findings, we recommend that the Business Model Canvas be integrated into healthcare education, either as a core or elective component. It encourages patient-centered entrepreneurial thinking and serves as a valuable link between professional expertise and business success.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

ZGODNJA FIZIOTERAPEVTSKA OBRAVNAVA OTROK Z OBPORODNIMI DEJAVNIKI TVEGANJA
EARLY PHYSIOTHERAPY TREATMENT OF CHILDREN WITH PERINATAL RISK FACTORS

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POVZETEK

Fizioterapevtska obravnava otrok v Sloveniji poteka v razvojnih ambulantah ter pod okriljem novega sistema centrov za zgodnjo obravnavo, ki jih določa Zakon o celostni zgodnji obravnavi predšolskih otrok s posebnimi potrebami (ZOPOPP). Namen naše raziskave je bil predstaviti obporodne rizične dejavnike, njihovo fizioterapevtsko obravnavo ter subjektivno mnenje staršev o obravnavi. Metode: Uporabili smo deskriptivno raziskovalno metodo, metodo kompilance, analize in sinteze, v empiričnem delu kvantitativno raziskovalno metodo, z uporabo anketiranja. Podatke smo pridobili preko spletnega anketnega vprašalnika in jih obdelali s statistično analizo, z uporabo Wilcoxonovega testa. v programu IBM SPSS. Vzorec je neslučajnostni in namenski, vključeval 139 žensk največ dve leti po porodu. Rezultati: V vzorcu je najpogostejši rizični dejavnik hipotonost (N=90; 64,7 %). 76,3 % (N=106) otrok je bilo najpogosteje napoteni na fizioterapevtsko obravnavo do 3. meseca starosti, na nevrološko razvojno fizioterapevtsko obravnavo v prvih šestih mesecih starosti. V v času do enega meseca po napotitvi je bilo v obravnavo vključenih samo tretjina, 36,7% otrok (N=51). Po mnenju anketirank je fizioterapevtska obravnava najpogosteje zajemala edukacijo staršev o baby handling metodi v domačem okolju (N=115, 82,7 %). Z obravnavo so bile preiskovanke v povprečju zelo zadovoljne (AS=4,5; SO=0,82), z informacijami o gibalnem razvoju, ki so jih prejele od fizioterapevta, pa v povprečju zadovoljne (AS=4,4; SO=0,87). Wilcoxonov test izraža statistično pomembno relevanco (p < 0,05). Razprava: Preiskovanke so fizioterapevtsko obravnavo otrok povprečno sprejele pozitivno, prav tako je stanje z njeno dostopnostjo v zadovoljivem stanju, a vendar bi bilo glede na strokovna priporočila priporočeno čakalno dobo za tovrstno fizioterapevtsko obravnavo skrajšati.

Ključne besede: *gibalni razvoj, rizični dejavniki, fizioterapevtska obravnava, razvojna nevrološka obravnava, odkloni od normalnega razvoja*

ABSTRACT

Physiotherapy treatment of children in Slovenia takes place in developmental clinics and within the new system of early intervention centers, as defined by the Act on Comprehensive Early Treatment of Preschool Children with Special Needs (Zakon o celostni zgodnji obravnavi predšolskih otrok s posebnimi potrebami (ZOPOPP)) . The aim of our research was to present perinatal risk factors, their physiotherapy treatment, and parents' subjective opinions regarding the treatment. Methods: We applied a descriptive research method, along with compilation, analysis and synthesis. In the empirical part, a quantitative research method was used, utilizing a survey. Data were collected through an online questionnaire and processed with statistical analysis using the Wilcoxon test in IBM SPSS. The sample was non-random and purposive, including 139 women up to two years postpartum. Results: The most common risk factor in the sample was hypotonia (N=90; 64.7%). A total of 76.3% (N=106) of children were most frequently referred to physiotherapy treatment by three months of age, primarily to neurodevelopmental physiotherapy within the first six months of life. However, only a third (36.7%; N=51) of children were included in therapy within one month of being referred. According to the respondents, physiotherapy treatment most often involved educating parents on baby-handling methods for use in the home environment (N=115; 82.7%). On average, respondents were very satisfied with the treatment (M= 4.5; SD = 0.82), and generally satisfied with the information about motor development provided by the physiotherapist (M = 4.4; SD = 0.87). The Wilcoxon test indicated statistically significant relevance ($p < 0.05$). Discussion: Respondents generally had a positive perception of physiotherapy treatment for their children. Access to treatment was also rated as satisfactory; however, based on professional recommendations, the waiting time for such physiotherapy treatments should be reduced.

Keywords: *Motor development, Risk factors, Physiotherapy treatment, Neurological developmental treatment, Deviations from normal development*

1 UVOD

Zgodnja obravnava otrok s posebnimi potrebami in otrok z rizičnimi dejavniki je celostna zgodnja obravnava otrok in njihovih družin. Obravnava otrok in njihovih družin, ki potrebujejo posebno skrb zaradi opaženih odstopanj v razvoju ali možnih dejavnikov tveganja, ki lahko vplivajo na razvoj (Zakon o celostni zgodnji obravnavi predšolskih otrok s posebnimi potrebami, 1. čl.) (v nadaljevanju ZOPOPP). »Otroci z rizičnimi dejavniki v predšolskem obdobju so otroci, pri katerih obstajajo rizični dejavniki za razvojne primanjkljaje, zaostanke, ovire ali motnje. Rizični dejavniki so dejavniki, ki nastanejo v nosečnosti, med rojevanjem ali takoj po porodu, in bi lahko vplivali na kasnejši otrokov razvoj. Rizični dejavniki se lahko pojavijo tudi kasneje zaradi bolezni ali slabega socialno-ekonomskega položaja družine« (ZOPOPP 4. čl.). Vendar pa ta ne predstavi podrobno, kaj ta obravnava zajema, njeno dostopnost in organizacijo (Šoln Vrbinc idr. 2016, 3).

Najpogostejši rizični dejavniki za nenormalen razvoj otroka se delijo na dejavnike, ki so bili prisotni pred spočetjem, prenatalne, perinatalne in neonatalne ter biološke dejavnike: nedonošenost, možganska krvavitev, zastoj rasti ploda v maternici, možganske nepravilnosti, asfiksija, mnogoplodni porod, itd. (Koražija Krajšek 2016, 36). Rizični dejavniki so lahko vzrok motnjam v psihomotoričnem razvoju otrok. Velika večina otrok z rizičnimi dejavniki kasneje ne kaže motenj v razvoju (Velikajne 1987, 33). Sadowska idr. (2020, 1508) delijo rizične dejavnike tveganja v naslednje kategorije: dejavniki tveganja, povezani z materinim stanjem pred spočetjem, ki so povezani z zdravstvenimi in življenjskimi pogoji matere; prenatalne, ki so povezani s potekom nosečnosti; perinatalni ter dejavniki tveganja v obdobju novorojenčka in dojenčka. Drugi viri, kot so Kulak idr. (2009) in McIntyre idr. (2012, 506), pa delijo dejavnike tveganja v tri podskupine: rizični dejavniki, povezani s predporodnim obdobjem, obdobjem nosečnosti in neonatalnim obdobjem. Statistično več se pojavlja deset dejavnikov tveganja pri otrocih, rojenih na predviden datum poroda (torej niso nedonošenčki ali prenošenčki): nepravilnosti placente, deformitete pri rojstvu (birth defects), nizka porodna teža, aspiracija mekonija, instrumentalni porod ali carski rez, asfiksija ob porodu, neonatalni krči, sindrom dihalne stiske, hipoglikemija in neonatalni infekti (McIntyre idr. 2012, 506).

Medsebojno vplivanje okoljskih in bioloških faktorjev spreminja potek gibalnega razvoja skozi otroštvo in odraslo dobo. Prezgodnji porod, motnje hranjenja, nivo telesne pripravljenosti, biomehanski faktorji in tudi psihološke spremembe v povezavi s staranjem in življenjskimi navadami, vplivajo na vseživljenjski proces gibalnega razvoja (Goodway idr. 2020,11). Glavni cilj normalnega motoričnega razvoja otroka je doseči funkcionalno neodvisnost skozi samostojno hojo in manipulacijo rok. Če vse poteka gladko, otrok doseže normalen nevromotoričen razvoj skozi igro in stimulacijo, ki jo pridobi iz okolja, brez težav ali večjih zamud. Če pa je otrokov motorični razvoj zakasnjen ali prekinjen, je fizioterapevtska obravnava ključna (Novak Orlić idr. 2021, 65).

Termin zgodnja intervencija ali obravnava otrok se nanaša na multidisciplinarne storitve, ki otroku od rojstva do šestega leta starosti nudijo spodbujanje zdravja in dobrega počutja, krepitev kompetenc, zmanjšajo zamude pri razvoju, odpravljajo obstoječe nezmožnosti, preprečujejo funkcionalna poslabšanja in spodbujajo vključevanje staršev in družinske obravnave otroka (Sant idr. 2021, 1). Fizioterapevtska obravnava se razlikuje glede na diagnozo. Najpogosteje se fizioterapevt vključuje v proces obravnave nedonošenčkov, intervencije pri dojenčkih, ki potrebujejo operacijo, obravnavo dojenčkov z nevrološkimi okvarami ter druge intervencije, ki jih dojenček s fizioterapevtskega vidika potrebuje (Versaw-Barnes in Wood 2015, 140–160). Fizioterapevtska obravnava je sestavljena iz štirih komponent: 1. koordinacija, komunikacija in dokumentacija; 2. informacije in napotki za pacienta; 3. postopkovne intervencije. Zadnji, četrti del je sestavljen iz evalvacije, kjer predstavimo rezultate intervencije, ali smo dosegli vse zastavljene cilje, katerih nismo dosegli in ali je bila naša intervencija učinkovita (Schreiber in Palisano 2023, 9–11).

Zgodnje prepoznavanje obporodnih rizičnih dejavnikov je ključno – kot tudi zgodnja fizioterapevtska obravnava, ki ima velik vpliv na zagotavljanje najboljšega možnega razvoja otroka, zato je pomembna informiranost zdravstvenega osebja in staršev in hitro ukrepanje, da otroku s celostno obravnavo zagotovimo najboljše možne rezultate in kakovostno življenje. S tem razlogom smo v našem diplomskem delu želeli ugotoviti, kateri so bili najpogostejši rizični dejavniki za nastanek potreb po nevrološko-razvojni fizioterapevtski obravnavi v našem vzorcu, kaj je zajemala fizioterapevtska obravnava otrok s prisotnimi rizičnimi dejavniki ter subjektivno zadovoljnost staršev.

2 NAMEN IN CILJI

Namen raziskave je predstaviti zgodnjo fizioterapevtsko obravnavo otrok z obporodnimi rizičnimi dejavniki ter njeno vsebino, ob tem pa istočasno preveriti informiranost staršev otrok, vključenih v zgodnjo fizioterapevtsko obravnavo, predstaviti rizične dejavnike, ki so spremljali otroka pred rojstvom, ter preveriti subjektivno zadovoljstvo staršev.

Cilji raziskave:

- Ugotoviti najpogosteje prisotne rizične dejavnike pred porodom in po porodu v našem vzorcu preiskovancev.
- Ugotoviti čas vključitve otrok v našem vzorcu v fizioterapevtsko obravnavo.
- Ugotoviti časovno obdobje trajanja vključenosti v fizioterapevtske obravnave pri našem vzorcu otrok.
- Ugotoviti vrsto fizioterapevtskih postopkov, uporabljenih v našem vzorcu.
- Ugotoviti subjektivno oceno staršev o stopnji informiranosti o gibalnem razvoju otroka s strani fizioterapevta in njihovem zadovoljstvu s fizioterapevtsko obravnavo v našem vzorcu.

Raziskovalne hipoteze:

H1: Predpostavljamo, da je najpogostejši razlog napotitve na nevrološko razvojno fizioterapevtsko obravnavo hipotonost.

H2: Predvidevamo, da so bili otroci v največjem deležu napoteni na nevrološko razvojno fizioterapevtsko obravnavo v prvih šestih mesecih starosti ter vključeni v obravnavo po enem mesecu od napotitve.

H3: Razvojno-nevrološka fizioterapevtska obravnava je najpogosteje zajemala edukacijo staršev o pravilnem rokovanju z dojenčkom.

H4: Subjektivna ocena zadovoljstva staršev o fizioterapevtski obravnavi otroka je povprečno opredeljena kot odlična (zelo zadovoljni), medtem ko je ocena o informiranosti staršev glede gibalnega razvoja otroka povprečno dosegla oceno dobro (zmerno zadovoljni).

3 METODE

Diplomsko delo je sestavljeno iz dveh delov, teoretičnega in empiričnega. V teoretičnem delu smo uporabili deskriptivno raziskovalno metodo obdelave podatkov, ki vključuje pregled slovenske in tuje literature, vezane na temo diplomske naloge. Uporabili smo tudi metodo kompilance (povzemanje) in metodo analize in sinteze. Podatke smo pridobili iz znanstvenoraziskovalnih člankov, strokovnih člankov ter s pomočjo slovenskih in tujih knjig. Pri iskanju literature smo uporabili spletne podatkovne baze, kot so COBISS, Pubmed, MEDLINE, PEDro in stran Academy of Pediatric Physical Therapy of the American Physical Therapy Association. Ključne besede, ki smo jih uporabili, so gibalni razvoj, zgodnja fizioterapevtska obravnava, rizični dejavniki, razvojno-nevrološka okvara (motor development, early physiotherapy, neurodevelopmental treatment, risk factors). Omejili smo se na članke in literaturo v slovenskem in angleškem jeziku, ki je izšla po letu 2000. V empiričnem delu bomo uporabili kvantitativno raziskovalno metodo z uporabo anketiranja. Podatke smo zbirali s pomočjo spletnega anketnega vprašalnika. Ustvarili smo ga s pomočjo brezplačnega orodja za izdelavo spletnih anket EnKlikAnketa (1kA) na spletni strani https://www.1ka.si/. Vprašalnik smo objavili na družbenih omrežjih. Podatke smo zbrali v mesecu juniju. Anketni vprašalnik je namenjen ženski populaciji po porodu živorojenega otroka in do njegovega drugega leta starosti. Vprašalnik je sestavljen s pomočjo obrazca slovenskega registra cerebralne paralize (obrazec SRCP) (Troha Gergeli 2021), ter druge literature s področja fizioterapevtske obravnave in obporodnih rizičnih dejavnikov. Anketni vprašalnik je zajemal 19 vprašanj, od tega so vprašanja odprtega, zaprtega in mešanega tipa. Prvi del se nanaša na pridobivanje osebnih podatkov, drugi del na rizične dejavnike, tretji del na fizioterapevtsko obravnavo ter četrti del na subjektivno zadovoljstvo staršev. Anketiranje je bilo anonimno in sodelovanje prostovoljno. Podatke smo obravnavali v skladu z vsemi členi Splošne uredbe o varstvu osebnih podatkov in Zakonom o varovanju osebnih podatkov. Anketiranke so lahko v vsaki fazi anketiranja odstopile. Pri zbiranju podatkov smo uporabili neslučajnostno metodo vzorčenja, kar je

povzročilo neenakomerno zastopanost regij. Rezultate smo predstavili opisno in tabelarično. Za obdelavo podatkov smo uporabili programa IBM SPSS Statistics in Microsoft Excel. Na podlagi obdelanih podatkov smo izvedli opisno statistično analizo, s katero smo podali povprečja, srednje vrednosti, standardne odklone, minimume in maksimume. Uporabili smo Wilcoxonov neparametrični test.

4 REZULTATI

Ugotovimo smo, da je bil najpogostejši razlog za vključitev v zgodnjo fizioterapevtsko obravnavo hipotonija (N = 90, 64,7 %). Sledil je odgovor drugo (N = 35, 25,2 %), odgovori, podani pod drugo, so bili: hiperlaksni sklepi, asimetrično držanje glavice, asimetrija, močno poležane nogice, zlom ključnice, ekstenzija (večkrat). Na tretjem mestu je upočasnjen ali disharmoničen razvoj (ne dosega razvojnih mejnikov) (N = 27, 19,4 %), sledijo rizični dejavniki (v času nosečnosti in po porodu) (N = 24, 17,3 %). 15 (10,8 %) je bilo vključenih zaradi hipertonije, sledi nenormalna nevrološka simptomatika (N = 5, 3,6 %). Najmanj otrok je bilo vključenih zaradi prepoznanega sindroma (N = 3, 2,2 %).

Starost pri kateri so bili otroci napoteni na fizioterapevtsko obravnavo je predstavljen v Tebeli 1 ter čas vključitve v fizioterapevtsko obravnavo v Tabeli 2.

Tabela 1: Starost ob napotitvi na fizioterapevtsko obravnavo

	Frekvenca	Odstotek
0-3 mesece	62	44,6 %
3-6 mesecev	44	31,7 %
6-8 mesecev	14	10,1 %
8-12 mesecev	16	11,5 %
12-24 mesecev	3	2,2 %
Se ne spomnim.	0	0,0 %
Skupaj	139	100,0 %

(Vir: Lastni vir 2024.)

Tabela 2: Čas vključitve v fizioterapevtsko obravnavo

	Frekvenca	Odstotek
Do 1 meseca po napotitvi	51	36,7 %
Do 2 meseca po napotitvi	26	18,7 %
Do 3 mesece po napotitvi	23	16,5 %
Do 4 mesece po napotitvi	13	9,4 %
Do 5 mesecev po napotitvi	8	5,8 %
Do 6 mesecev po napotitvi	7	5,0 %
Več kot 6 mesecev po napotitvi	7	5,0 %
Drugo	4	2,9 %
Skupaj	139	100,0 %

(Vir: Lastni vir 2024.)

Preverili smo tudi kaj je po mnenju mater zgodnja fizioterapevtska obravnava zajemala. Najpogosteje je zajemala učenje staršev, kako se izvajajo vaje za spodbujanje pravilnega razvoja otroka v domačem okolju (N = 115, 82,7 %), sledi učenje staršev o pravilnem rokovanju z otrokom (N = 104, 74,8 %). Nato sledi fizioterapevtova manualna obravnava otroka (razgibavanje, masaža ipd.) (N = 79, 56,8 %). Na četrtem mestu je razvojno-nevrološka obravnava otroka (za doseganje razvojnih mejnikov) po konceptu Bobath (N = 37, 26,6 %), ki ji sledi razvojno-nevrološka obravnava otroka (za doseganje razvojnih mejnikov) po konceptu Vojta (N = 15, 10,8 %). Odgovor drugo

je bil naslednji najpogostejši odgovor (N = 5, 3,6 %), kjer je bilo podano: telovadba in vaje za sproščanje, kraniosakralna terapija in bownova terapija, se ne spomnim, razvojno-nevrološka obravnava, vendar ne vem, po katerem konceptu ... Temu je sledila obravnava s pomočjo pripomočkov (therasuit terapija z vpenjanjem otroka, računalniška tehnologija ipd.) (N = 2, 1,4 %). N = 1, 0,7 % odgovorov je bilo za obravnavo z elektroterapijo in drugimi aparaturami ter terapija ni vsebovala nič od naštetega.

Tabela 3: Wilcoxonov test za oceno zadovoljstva z razvojno fizioterapevtsko obravnavo in oceno zadovoljstva z informacijami o gibalnem razvoju, prejetimi od fizioterapevta na fizioterapevtski obravnavi

	AS	SO	Me	Testna Me	Wilcoxonov test	p
Zadovoljstvo z razvojno fizioterapevtsko obravnavo	4,5	0,82	5	5	-7,067	0,000
Zadovoljstvo z informacijami o gibalnem razvoju	4,4	0,87	5	3	9,524	0,000

Legenda: AS - aritmetična sredina, SO - standardni odklon, Me - mediana, Testna Me - testna mediana, p - statistična pomembnost
(Vir: Lastni vir 2024.)

5 RAZPRAVA

V našo raziskavo smo vključili 139 popolno izpolnjenih anket mamic, katerih otroci so bili do drugega leta starosti vključeni v razvojno fizioterapevtsko obravnavo. V raziskovalnem delu diplomskega dela smo si postavili štiri hipoteze.

V hipotezi ena smo preverjali, kateri je najpogostejši razlog za vključitev otrok v zgodnjo fizioterapevtsko obravnavo. Predvidevali smo, da je najpogostejši razlog za vključitev hipotonost. Slabi dve tretjini 64,7 % (N = 90) žensk v našem vzorcu je odgovorilo, da je bil razlog za napotitev na zgodnjo fizioterapevtsko obravnavo hipotonija njihovega otroka. Ker je bilo na vprašanje več mogočih odgovorov, so bile lahko zraven hipotonosti pri otrocih prisotne tudi druge diagnoze. Veliko mamic je tudi pod odgovor drugo dopisalo diagnozo svojega otroka, ki je privedla do potrebe po fizioterapevtski intervenciji (N = 35, 25,2 %). Rizični dejavniki v času nosečnosti ali po porodu pa so v našem vzorcu predstavljali le 17,3 % vseh odgovorov (N = 24). Hipotezo ena tako lahko potrdimo, saj je večina otrok v našem vzorcu fizioterapevtsko obravnavo obiskovalo zaradi hipotonosti.

Yozawitz idr. (2018, e446) v svoji študiji predstavijo, da je generalizirana hipotonija pogost klinični pojav pri novorojenčku – lahko je manifestacija sistemske bolezni, disfunkcije centralnega ali perifernega živčnega sistema. Hipotonija ali nizek mišični tonus je prepoznan kot ena od najpogostejših motenj v obdobju, ko je otrok novorojenček.

V drugi hipotezi smo preverjali, kdaj so bili otroci napoteni na nevrološko razvojno fizioterapijo in kdaj so bili vanjo vključeni. Predvidevali smo, da so bili otroci v največjem deležu napoteni na nevrološko-razvojno fizioterapevtsko obravnavo v prvih šestih mesecih starosti ter vključeni v obravnavo po enem mesecu od napotitve. V anketi smo ugotovili, da so zdravstveni delavci največ otrok v našem vzorcu napotili na zgodnjo fizioterapevtsko obravnavo do 3. meseca (N = 62, 44,6 %) ter v obdobju od 3. do 6. meseca (N = 44, 31,7 %), kar pomeni, da je bilo 76,3 % (N = 106) otrok napotenih na nevrološko razvojno fizioterapevtsko obravnavo v prvih šestih mesecih starosti (Tabela 1). Ugotovili smo tudi, da je bilo v času do enega meseca po napotitvi v obravnavo vključenih samo 36,7 % otrok (N = 51), torej samo dobra tretjina otrok. Hipotezo dva potrdimo, saj je bila v našem vzorcu večina otrok napotena na zgodnjo fizioterapevtsko obravnavo v prvih šestih mesecih starosti in vključenih po enem mesecu od napotitve.

Morgan idr. (2021, 22) so v svojem sistematičnem pregledu literature predstavili internacionalna klinična navodila za izvajanje zgodnje intervencije. Podajo, da je intervencijo treba začeti čim prej, tudi starši si želijo zgodnje diagnoze in zdravljenje ter podpirajo čimprejšnjo izvedbo zgodnje fizioterapevtske obravnave. Začetek intervencije se priporoča ob sumu na diagnozo, saj je treba izkoristiti nevroplastičnost možganov s specifičnim treningom, odsvetuje se čakanje, ker lahko zamudimo kritično okno nevromuskolatorne plastičnosti (Novak idr. 2017, 3).

V hipotezi tri smo preverjali kaj je nevrološka fizioterapevtska obravnava najpogosteje zajemala. Predvidevali smo, da je fizioterapevtska obravnava najpogosteje zajemala edukacijo staršev o pravilnem rokovanju z dojenčkom. Raziskali smo, katere obravnave so bile najpogostejše uporabljene. 74,8 % (N = 104) mamic v našem vzorcu je odgovorilo, da je fizioterapevtska obravnava zajemala edukacijo staršev o pravilnem rokovanju z dojenčkom, 115 mamic (82,7 %) je odgovorilo tudi, da jih je fizioterapevt naučil, kako se izvajajo vaje za spodbujanje pravilnega razvoja otroka v domačem okolju. Tretjo hipotezo potrdimo, kar pomeni, da je razvojno-nevrološka fizioterapevtska obravnava najpogosteje zajemala edukacijo staršev o pravilnem rokovanju z dojenčkom. Le 26,6 % (N = 37) mamic je odgovorilo, da je terapija zajemala razvojno-nevrološko obravnavo otroka po konceptu Bobath in le 15 mamic (N = 10,8 %), da je terapija zajemala razvojno-nevrološko obravnavo po konceptu Vojta.

Morgan idr. (2021, 22) v raziskavi predlagajo, da fizioterapevtska obravnava zajema specifičen motorični trening glede na primanjkljaj, ki vključuje samostojno odkrivanje okolja in samostojno iskanje rešitev za premagovanje gibalnih izzivov, izbor zahtevnih, a dosegljivih motoričnih nalog, ki zahtevajo vztrajnost, vsakodnevno ponavljajočo se vadbo (če je to le mogoče), edukacijo staršev za samostojno spodbujanje raznolikosti gibanja njihovega otroka ter ustvarjanje bogatega spodbudnega okolja. Kalucka idr. (2022) v svoji študiji navajajo, da je bila najbolj pogosta metoda fizioterapevtske obravnave v njihovem vzorcu metoda Bobath, ki je bila uporabljena pri kar 74 % dojenčkov. Nevrofizioterapevtska obravnava otrok se v Sloveniji izvaja pod okriljem Razvojnih ambulant in temelji na metodi Bobath, dopolnjuje pa se s fizioterapevtskimi postopki in metodami, pridobljenimi z dodatnimi izpopolnjevanji, kot so mobilizacija živčevja, miofascialno sproščanje, uporaba elastičnih lepilnih trakov, dinamična nevromišična stabilizacija ipd. (Bukovec 2024, 29).

V četrti hipotezi smo preverjali subjektivno oceno zadovoljstva anketirank z obravnavo, ki so jo bile deležne, in z informacijami, ki so jih prejele. Predvidevali smo, da bo subjektivna ocena zadovoljstva staršev o fizioterapevtski obravnavi otroka povprečno opredeljena kot odlična (zelo zadovoljni), medtem ko bo ocena o informiranosti staršev glede gibalnega razvoja otroka povprečno dosegla oceno dobro (zmerno zadovoljni). Anketiranke so bile v povprečju z razvojno fizioterapevtsko obravnavo zelo zadovoljne (AS = 4,5; SO = 0,82), z informacijami o gibalnem razvoju, ki so jih prejele od fizioterapevta, pa so bile v povprečju zadovoljne (AS = 4,4; SO = 0,87). Hipotezo smo preverili z Wilcoxonovim neparametričnim testom. Wilcoxonov test za zadovoljstvo z razvojno fizioterapevtsko obravnavo (Wilcoxon test = -7,067; p = 0,000) in Wilcoxonov test za zadovoljstvo z informacijami o gibalnem razvoju (Wilcoxon test = 9,524; p = 0,000) sta statistično pomembna (p < 0,05), kar pomeni, da je srednja vrednost statistično pomembno višja od testne. Zato lahko četrto hipotezo delno potrdimo, kar pomeni, da je subjektivna ocena zadovoljstva staršev o fizioterapevtski obravnavi otroka povprečno opredeljena kot odlična (zelo zadovoljni), medtem ko je ocena o informiranosti staršev glede gibalnega razvoja otroka povprečno dosegla oceno prav dobro (zadovoljni).

Westcott McCoy idr. (2019, 144–145) so v svoji študiji ugotovili, da je bila ocena staršev o tem, ali obravnava izpolnjuje potrebe njihovih otrok, povezana s pogostostjo udeležbe družine v terapiji. Te ugotovitve torej kažejo na pozitivne rezultate, kadar terapevt razpravlja in sodeluje z družino ter omogoča, da družina sprejema odločitve o storitvah ter spoštuje želje in misli družine.

Opravljena raziskava je dobra osnova za nadaljnje raziskave, vendar se moramo zavedati, da raziskave ne moremo posploševati, saj je bilo v raziskavo vključenih samo 139 žensk, katerih otroci so obiskovali zgodnjo fizioterapevtsko obravnavo, prav tako se moramo zavedati, da raziskava ni bila enakomerno izpolnjena po regijah, skoraj četrtina anketirank namreč prihaja iz podravske regije. Vemo namreč, da so čakalne dobe po različnih regijah Slovenije različno dolge, kar bi lahko vplivalo na rezultate druge hipoteze. V prihodnje bi bilo priporočljivo raziskavo opraviti na večjem vzorcu in razširili kriterij vključitve v raziskavo – tako bi na primer vključili otroke do šestega leta starosti in dobili vpogled v stanje celotne predšolske populacije otrok, ki bi bili vključeni v našo raziskavo.

6 ZAKLJUČEK

Fizioterapevtska obravnava otrok je obširen pojem, ki zajema veliko različnih oblik terapije, konceptov, pripomočkov in edukacije. Z raziskovalnim delom smo ugotovili, da je v sklopu fizioterapevtske obravnave otroka v našem vzorcu prevladovala edukacija staršev o pravilnem rokovanju z otrokom in o vajah za spodbujanje pravilnega gibalnega razvoja. Zaradi nevroplastičnosti možganov je pomembno, da se fizioterapevtska obravnava začne čim prej. Otroci v naši raziskavi so bili na zgodnjo fizioterapevtsko obravnavo v večini napoteni v prvih šestih mesecih starosti in bili nato vanjo v večini vključeni v času po enem mesecu, kar smo pričakovali. Rizični dejavniki, ki vplivajo na otroka in so povod za obisk nevrološke razvojne fizioterapije, se lahko pojavijo že v času nosečnosti, med porodom ali po njem. Najpogostejši rizični dejavnik za vključitev v obravnavo v našem vzorcu je bila hipotonija, prisotna pri več kot polovici otrok v našem vzorcu, manj je bilo rizičnih dejavnikov, ki so bili prisotni pred porodom ali med njim. Glede na podatke, ki smo jih pridobili z diplomskim delom, lahko zaključimo, da so bili starši z razvojno-nevrološko fizioterapijo zelo zadovoljni, vendar bi si želeli še več informacij fizioterapevta o gibalnem razvoju.

Po končani raziskavi smo prišli do zaključkov, da so starši v našem vzorcu fizioterapevtsko obravnavo sprejeli pozitivno, prav tako lahko zaključimo, da je stanje z dostopnostjo fizioterapevtske obravnave v našem vzorcu v zelo zadovoljivem stanju, vendar bi bilo priporočeno čakalno dobo za razvojno fizioterapevtsko obravnavo še strajšati, da se lahko še izboljša njen rezultat. Priporočamo povečanje samega kadra razvojno nevroloških fizioterapevtov. Ugotavljamo, da je hipotonija eden od največjih dejavnikov, ki je vplival na gibalni razvoj otrok v našem vzorcu.

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HEALTH SCIENCES

1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

EFFECT OF PARO ROBOT INTERVENTIONS ON PEOPLE WITH DEMENTIA: A SYSTEMATIC REVIEW

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ABSTRACT

Introduction: Care for people with dementia includes pharmacological and non-pharmacological interventions. With the development of technology, robots have been developed to help the elderly population with dementia. Purpose: The aim of this systematic review was to explore the current global evidence regarding the effect of the PARO robot intervention in elderly people with dementia. Methods: We performed a systematic review of literature according to PRISMA. Methodological quality was assessed using Joanna Briggs Institute tools. Results: Paro robot intervention has several advantages, is at low risk and non-pharmacological, is generally well accepted by patients and staff and can be used in group or individual settings. PARO robot interventions offer moderate, clinically meaningful improvements in behavioral and psychological symptoms of dementia, particularly for social engagement and mood, reduce agitation and medication use, however, benefits vary by individual characteristics and intervention design, and practical limitations remain. In case of agitation, the effects seem to be modest, especially in those with less severe symptoms. Effects are comparable to other non-pharmacological interventions, but individual responses vary. On the other hand, for cognitive outcomes improvements are limited or inconsistent. especially in those with less severe symptoms.

Conclusion: More rigorous, large-scale studies are still needed to clarify optimal use and long-term impact of Paro robot intervention in patient with dementia.

***Keywords**: Dementia, Social robots, Artificial intelligence, PARO robot, Intervention*

1 INTRODUCTION

WHO declared dementia as a global public health priority of the 21st century (WHO and Alzheimer's Disease International 2012). Dementia is not a normal phenomenon of aging, but a disease that affects memory, cognitive abilities and behavior, and consequently hinders the ability to perform daily activities, making a person with dementia increasingly dependent on the help of others (GBD 2019, 2022). The term dementia is used to refer to a group of degenerative brain diseases, usually occurring in old age (but not exclusive to older people), which result in a progressive decline in a person's cognitive abilities such as memory, speaking skills, attention, movements and the ability to plan and organize. Brain function is impaired to the point that it interferes with a person's normal social and work life. The main feature of dementia is the inability to perform daily activities as a result of cognitive decline (Bevilacqua et al. 2023). The risk of dementia increases with age. In 2015, the world had an estimated 50 million older people with dementia and this number is predicted to increase to 82 million by 2040 and to 152 million by 2050 (GBD 2019 2022, WHO).

Care for people with dementia includes pharmacological and non-pharmacological interventions. Non-pharmacological interventions could include e.g. exercise and pet therapy (Scales et al. 2018). Engaging in activities is one of the key elements of good dementia care. Other cognitive rehabilitation therapies and protocols focus on the recovery and/or maintenance of cognitive abilities such as memory, orientation, and communication skills (Tapus 2009).

With the development of technology social robots have been developed to assist the elderly population with dementia. A social robot is an artificial intelligence (AI) system designed to interact with humans and other robots using social behavior (Broekens et al. 2009). Two reviews suggest that robot intervention is a potentially useful part of treatment for dementia as it has the advantage of improving mood, encouraging social interaction and communication, helping individuals in their daily lives, improving the well-being of the elderly and reducing the workload of their caregivers (Bemelmans et al. 2012; Kachouie et al. 2014).

The most popular companion robot for elderly people with dementia is the social robot, PARO. Designed in Japan by Shibata, Paro, the cuddly baby harp seal robot, is an interactive robot with five types of sensors: light, touch, posture, temperature and audio. PARO is known as a companion robot, social robot, seal robot (Jones et al. 2015; Moyle et al. 2013) and as tool for non-pharmacological intervention (Shibata 2012).

Paro has the ability to improve social interaction between people, reduce stress and loneliness, and even increase immune system function (Broekens et al. 2009; Shibata 2012). It seems that Paro has the potential to improve psychological (e.g. reductions in anxiety and depression) and physiological well-being and improve the overall quality of life and even in cognitive functioning (Bevilacqua et al. 2023). Used in healthcare settings, robots like Paro provide therapeutic assistance to elderly patients, helping reduce anxiety, pain, and stress during treatment and to provide companionship, especially for dementia patients. PARO has been found to improve social engagement in individuals with dementia, increasing participation in activities and promoting more spontaneous communication. Additionally, improvements in positive emotions and behaviors have been demonstrated in individuals with dementia interacting with PARO (Petersen et al. 2016; Øranson et al. 2015). Interventions with pet robots seems to be effective treatment strategies for the elderly with cognitive impairment and dementia. These types of patient interventions have been shown to have positive effects on behavioral and psychological symptoms of dementia (Leng et al. 2019; Park et al. 2020).

2 PURPOSE AND GOALS

Social robotics is a relatively new field. Overall, the effects of Paro on older adults with dementia in different aged care settings need to be further investigated. Thus, we conducted this systematic review of randomized controlled trials (RCTs) to comprehensively investigate the role of Paro in helping older adults with dementia.

3 METHODS

This systematic review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al. 2009).

3.1 Research strategy and criteria

PubMed and Google Scholar database were searched for articles published between 1/1/2010 and 30/06/2024 on the effects of the PARO robot in older adults with dementia. In conducting teh literature search we employed specific keywords "PARO robot," "seal robot," "social robot," "companion robot," "adult," "elderly," "randomized controlled trial" and by utilizing Boolean operators such as AND and OR, we constructed a systematic search strategy that combined these terms to capture relevant studies.

Inclusion criteria were randomized or quasi-experimental studies involving older adults with dementia using PARO as the primary intervention to improve psychosocial, behavioral, or functional outcomes. Exclusion criteria were studies on other types of robots, the general population, non-English publications, or non-peer-reviewed sources.

Titles and abstracts were screened for relevance, followed by full-text assessment. Duplicates were removed. Seven studies met the inclusion criteria and were included in the review.

3.2 Assessment of the quality of studies

The quality of included studies was appraised using the Joanna Briggs Institute (JBI) Critical Appraisal Tools for randomized controlled and quasi-experimental studies (Barker et al., 2023).

3.3 Data collection

Data were meticulously extracted from the selected articles to provide a comprehensive understanding of the impact of the PARO robot on elderly individuals with dementia.

The extraction process included detailed descriptions of the interventions, specifically how the PARO robot was utilized, along with the measurements and outcomes assessed. This encompassed the various assessment tools and metrics employed to evaluate the the robot's effectiveness in improving social support and outcomes..

By systematically extracting and documenting this information, a structured synthesis of evidence on the use of the PARO robot in dementia care was achieved.

Due to systematic review of literature the Ethical approval was not required.

4 RESULTS

A schematic view of the literature review is shown in Figure 1. Table 1 summarizes study characteristics, interventions, and outcomes.

Figure 1: Prisma flow diagram in the database literature review

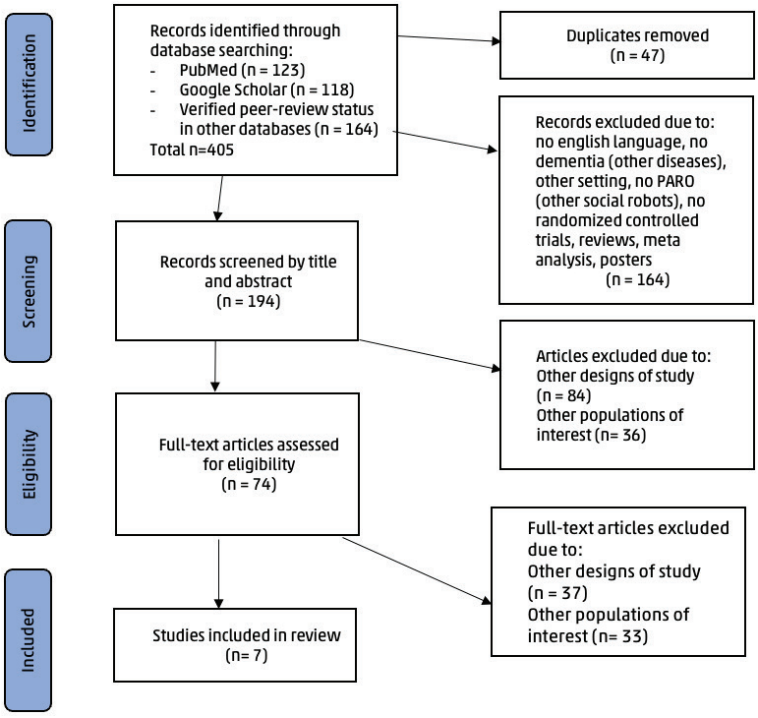

Table 1: Overview of the main findings of the use of the PARO robot in older people with dementia

Main Results	Measurments	Intervention	Participants	Setting	Design	Purpose / objectives	Author / year of publicati-on/country
- Greater interest in PARO than in Lion. Significantly higher frequencies of talking to and positive changes in emotional expression with PARO than with Lion, while laughing was slightly higher with PARO. - M group: significant higher difference in talking to PARO, they spent better time with PARO and less talking to the staff member. - in S-group: those with severe dementia were more affective with PARO than with Lion.	Video-taped and coded, qualitative analysis was used to code the open-ended questions	Observation of recordings and analysis of behavioral responses of people with dementia to the Paro intervention compared to the control group	M group: 19 with mild/ moderate dementia and S-group: 11 subjects with severe dementia	The nursing home and a day care center	Experimen-tal study	To analyze the differences in verbal and emotional responses to PARO vs. stuffed lion toy: Lion	Takayanagi, Kirita and Shiba-ta/2014/ Spain
For the therapeutic interventions, the effectiveness of Paro is clearly demon-strated. For interventions aiming at care support, this study shows no significant effect. Paro should be seen as a tool for care staff and not as a replacement of care.	Scale assessments: individually problems, mood, behavior in psychogeriat-ric inpatients	Two types of interventions: one for therapeutic purposes and other to facili-tate daily care activities	91 patients with de-mentia, in all stages of dementia	8-10 residents in each unit, 6 locations, 3 care institu-tions	Multicenter quasi-ex-perimental study.	To assess both the short-term effects of the Paro inter-ventions on psychological functioning and well-being care providers.	Bemelmans et al. /2015/ Netherland
PARO interventions significantly reduced symptoms of anxiety and depression and use of psychoactive medications and pain medications.	Rating for Anxiety in Dementia, Cornell Scale for Depression in Dementia, The Global Deterioration Scale, pulse rate, pulse oximetry, galvanic skin response	Iintervention group: PARO, 20-min sessions 3 times a week for 3 months. Control group: standard care (e.g. music, physical activity)	61 patients, 77% fema-les, average 83.4 years, control (n=26) and treatment groups (n=35)	5 urban secure dementia units	A randomi-zed with repeated measure-ments	To evaluate the effectiveness of the PARO in de-mentia-related symptoms	Petersen et al./2016/ USA

PARO significantly improved the quality of life for those with severe dementia, maintaining stable quality of life scores compared to a decrease in the control group. The intervention group used significantly less psychotropic medication compared with the control group	Quality of Life Scale	Group activity for 30 minutes twice a week for 12 weeks.	27 participants participated in group activity and 26 participated in the control group.	10 nursing home units with intervention or control group (treatment as usual).	A cluster-randomized controlled trial	To examine the impact of Paro robot on the quality of life	Jøranson et al. /2016/ Norway
PARO significantly improved engagement, mood states, and agitation in dementia patients living in long-term care facilities compared to usual care	Video observation and analysis (Video Coding forms of engagement).	9 facilities PARO group (individual sessions 3 times per week for 10 weeks), 10 to plush toy and 9 to usual care Treatment allocation was masked to assessors.	415 participants	28 long-term care facilities, by 20 care organizations.	Cluster-Randomized Controlled Trial	To test PARO when ompared with plush toy and usual care, on the emotional and behavioral symptoms .	Moyle et al. /2017/ Australia
Significant improvement in facial expressions and interactions with staff at the day care center. Reducing anxiety and improving mood. Beneficial effects of Paro on emotional and social functioning, particularly in those with higher cognitive functioning. No significant differences in the behavioral and physiological measures between the intervention.	Observations at day care centers and measures at home: cognitive level, hair samples, inventories	30-minute group sessions 2–3 times a week for 6 weeks in 2 day dementia centers and in participants' homes	30 dyads: patients in dementia day care and their informal caregivers	A day care center & a home environment	Pilot randomized controlled trial	To investigate the affective, social, behavioral and physiological effects of the Paro robot	Liang et al. /2017/New Zealand
The use of PARO has shown improved well-being outcomes for participants in a home care setting. The potential benefits of PARO are more related to the individual's interest level rather than the severity of dementia.	Interviews and observations during monthly visits.	7 families used PARO for at least 3 times a week for 1-3 months	Patients with dementia who are expected to benefit from PARO use	In home	A randomized controlled trial	To assass the PARO use provided by the family and to identify problems when using PARO at home	Inoue, Wada and Shibata/2021/ Japan

Study designs were experimental, with settings including nursing homes, day care centers, dementia units, and home-based care.

Assessment instruments varied across studies, including cognitive and functional measures, behavioral and psychiatric scales, quality of life measures, physiological measures (e.g. pulse, pulse oximetry), and direct observations of engagement, mood, and agitation. All instruments were validated and widely used.

5 DISCUSSION

This review underly that interventions with the PARO robot can improve symptoms and quality of life in elderly people with dementia. Takayanagi et al. (2014) highlighted enhanced social interaction and initiation of conversation. Bemelmans et al. (2015) and Petersen et al. (2016, 569 - 574) reported reductions in anxiety and depression. Jøranson et al. (2016, 3020-3033) emphasized the value of personalized interventions. Moyle et al. (2017, 766-773), Liang et al. (2017, 871-878), and Inoue et al. (2021) documented improved engagement and mood, particularly among participants with higher cognitive levels.

Several other authors similarly reported that PARO robot interventions have demonstrated effectiveness in improving agitation, anxiety, depression, quality of life, mood, and social engagement, and can reduce use of psychotropic medications (Bevilacqua et al. 2023; Chen et al. 2024, 105228; Hung et al. 2019; Jøranson et al. 2015, 867-73; Kang et al. 2020; Moyle et al. 2013; Rashid et al. 2023, 104530). Effects are generally more pronounced for behavioral and psychological symptoms than for cognitive outcomes, where improvements are limited or inconsistent (Hirt et al. 2020, 773 – 792; Chen et al. 2024, 105228; Soler et al. 2015). Some other studies also report reductions in pain and medication use, and improvements in physiological stress markers (Chen et al. 2024, 105228; Demange et al. 2018, 1303 – 1311; Pu et al., 2020). Similarly as in our case (Jøranson et al. 2016, 3020-3033; Petersen et al. 2016, 569 - 574), effectiveness, while moderate, were reported for agitation, anxiety, depression (Jøranson et al. 2015, 867-73; Rashid et al.

2023, 104530; Yu et al. 2022; Kang et al. 2020). Several studies report moderate effectiveness in better mood, social engagement and quality of life (Chen et al. 2024, 105228; Bevilacqua et al. 2023; Hung et al. 2019; Jones et al. 2018, 623-626; Liang et al. 2017, 871-878; Yu et al. 2015), pain reduction (Demange et al. 2018, 1303 - 1311; Pu et al., 2020), reduction in medication use (Jøranson et al. 2015, 867-73; Rashid et al. 2023, 104530; Yu et al. 2022; Kang et al. 2020), while effect on cognitive function are limited (Chen et al. 2024, 105228; Hirt et al. 2020, 773 - 792; Soler et al. 2015). Some studies show long-term benefits in reducing depression and agitation, and decreasing the use of psychotropic and pain medications (Jøranson et al. 2015, 867-73; Jøranson et al. 2016, 3020-3033; Petersen et al. 2016, 569 - 574; Pu et al. 2020).

Meta-analyses and systematic reviews consistently report that PARO robot interventions lead to a small to moderate reduction in agitation among people with dementia (Ong et al. 2021, 381-394; Rashid et al. 2023, 104530; Fan et al. 2025). These effects are statistically significant but not large, and the overall quality of evidence is considered low to moderate due to methodological limitations and sample size (Ong et al. 2021, 381-394; Rashid et al. 2023, 104530).

Randomized controlled trials show mixed results. Some studies found no statistically significant difference in agitation between use of PARO, plush toy, and usual care groups after 10 weeks (Mervin et al. 2018, 619-622.e1; Moyle et al. 2017, 766-773). However, other trials observed significant reductions in agitation in the PARO group, especially over longer-term follow-up (e.g., 3 months) or during/shortly after sessions (Jøranson et al. 2015, 867-73; Cacchione et al. 2023, 930 - 930). Short-term improvements in agitation have also been documented (Cacchione et al. 2023, 930 - 930).

PARO interventions can modestly reduce agitation in those with less severe symptoms. Effects are comparable to other non-pharmacological interventions, but individual response varies. PARO is more effective for individuals with low to moderate agitation and less severe cognitive impairment. Those with severe agitation may show little or no benefit (Jones et al. 2018, 623-626; Demange et al. 2018, 1303 - 1311). Results may vary depending on session frequency, duration, and facilitation (Jøranson et al. 2015, 867-73; Moyle et al. 2017, 766-773; Rashid et al. 2023, 104530). PARO is generally as effective as non-robotic plush toys for agitation reduction, but may offer additional benefits for engagement and pleasure (Mervin et al. 2018, 619-622.e1; Moyle et al. 2017, 766-773). The overall quality of evidence is considered low to moderate due to methodological limitations, small sample sizes, and heterogeneity in intervention approaches (e.g., group vs. Individual) (Rashid et al. 2023, 104530 ; Yu et al. 2022; Hirt et al. 2020, 773 - 792).

Among advantages in using Paro interventions authors reported improved mood, social interaction, and quality of life (Kang et al. 2020; Jøranson et al. 2016, 3020-3033; Bevilacqua et al. 2023; Moyle et al., 2013; Liang et al. 2017, 871-878), reduced negative behavioral symptoms and medication use (Rashid et al. 2023, 104530; Petersen et al. 2016, 569 - 574; Jøranson et al. 2015, 867-73; Pu et al. 2020), intervention are at low risk and non-pharmacological (Rashid et al. 2023, 104530; Kang et al. 2020; Hung et al. 2019). In addition they can be used in group or individual settings, and is generally well-accepted by patients and staff (Bevilacqua et al. 2023; Hung et al. 2019; Yu et al. 2015). Among limitations authors reported small sample sizes and methodological variability (Hirt et al. 2020, 773 – 792; Rashid et al. 2023, 104530), less pronounced effects in individuals with severe agitation or cognitive impairment (Jones et al. 2018, 623-626; Hirt et al. 2020, 773 - 792), high cost and maintenance (Hung et al. 2019), stigma, ethical issues for use of robots (Hung et al. 2019).

Limitations of this study include small samples, short observation time of interventions, while the findings are not applicable to the entire population of people with dementia. Advantages include a longer review period for publications and the selection of controlled double-blind studies.

6 CONCLUSION

Overall, PARO represents a promising tool for enhancing person-centered dementia care, but future research are needed especially those exploring long-term outcomes, optimal session frequency and duration, cost-effectiveness, and for strategies for personalized implementation to maximize benefits.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

RECENT ADVANCES AND FUTURE DIRECTIONS IN NANOMEDICINE: MILESTONES, THERAPEUTIC APPLICATIONS AND SAFETY CONSIDERATIONS[1]

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ABSTRACT

The progress of nanomedicine as one of the crucial fields of nanoscience and nanotechnology (N&N) is fascinating. In recent years, along with nanomaterials and nanoelectronics, nanomedicine has become the third pillar on which the development of N&N rests. In this review we will present ten nanotechnology milestones in medicine to date. Methodically, we rely on experimental methods of physical deposition, chemical reactions, self-assembly and evaluation of the properties of nanoparticles and other nanostructures, including their toxic effects, penetration through barriers and their use as drug carriers. We document the potential of nanomedicine using an analysis of publication activities according to the Scopus database, which testifies to the rapid growth of publication in this area. From the wide spectrum of applications of nanomedicine, whether in diagnostics, therapy, vaccination, prosthetics, etc., we will select three significant examples: antimicrobial nanoparticles and its applications, targeted drug delivery to the relevant organs and/or tumors, and therapy of various diseases by means of molecular hydrogen, which is a strong antioxidant. The review will be supplemented by results from our laboratory.

Keywords: *Nanomedicine, Milestones, Drug delivery, Antibacterial agents, Hydrogen nanotherapy*

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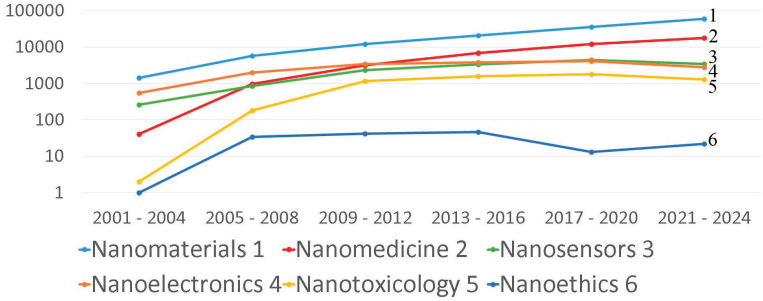
1 INTRODUCTION

The history of nanoscience and nanotechnology (N&N) began with Faraday, who prepared the first gold nanoparticles (NPs) (Faraday 1857). The philosophy and perspectives of modern nanoscience and further miniaturization were laid out by Feynman in 1959 in his lecture *There's plenty of room at the bottom* (Feynman 1960). The first national nanotechnology initiative was announced by W. Clinton in 2000. Since then, the development of N&N has swiftly accelerated. One of their organic parts is nanomedicine. More than 10 milestones in the development of N&N are associated with nanomedicine (Chap. 2). It is meaningful that after a backlash against biotechnology, a new approach to nanotechnology was chosen which involved broad social discussion. Today we can state that the hype over nanotechnology is long over (Seifert and Faitz 2021). At the same time, the number of publications in the field of nanomedicine has been growing fast. This applies to both books and journals.

Figure 1: Number of publications in four-year cycles in the field of nanomaterials, nanoelectronics, etc., in which the corresponding name of the field appears in the title, abstract or keywords in the Scopus database (January 12, 2025).



The growth of publications in individual fields of N&N is shown in Figure 1. Apparently, nanomedicine has the greatest growth momentum. The field of nanomaterials is growing more slowly, but with the largest total number of papers. (Materials are a prerequisite for the development of any experimental branch of N&N.) Nanoelectronics shows a plateau in terms of scientific papers; development of devices finds its reflection in patenting and chip design. Publications about nanosensors also show a similar shape, and after all, sensors are also a product of nanoelectronics; often they are even integrated on computer chips. Nanotoxicity and nanoethics studies have gone through maxima to a slow decline, as the assortment of nanomaterials is almost stable today. On the other hand, new strategies are emerging, such as "safer by design", which requires that all potential risks be eliminated or at least suppressed earlier in the innovation cycle of materials or structures (Brennan and Valsami-Jones 2021).

Nanomedicine has applications in diagnostics, therapy, vaccination, prosthetics, dentistry, and elsewhere. In this paper, we will focus on today's three therapeutic hot topics – antibacterial nanomaterials, targeted drug delivery, and molecular hydrogen nanotherapy. Unfortunately, other current topics such as diagnosis of a wide range of diseases from exhaled air with the use of nanosensors or electronic noses and various nanodiagnostics that reach a higher qualitative level thanks to the support of artificial intelligence exceed the set scope of this work.

The above applications rely on use of nanoparticles or other nanostructures, which are generally, but also in our laboratory, prepared by chemical reactions, physical depositions, self-assembly of arrays, and are investigated by X-ray diffraction, atomic force microscopy, Raman spectroscopy and a number of other methods.

2 MILESTONES IN NANOMEDICINE

The progress of N&N is lined by milestones that can be divided into various cathegories, such as phenomena, materials and structures, instruments and methods, devices and concepts. The lists

of these milestones has been repeatedly published (Luby 2016, 31–33; Bayda et al. 2020, 9–10; NNI 2025). The following milestones which arose in this field or in other fields but with a decisive impact on the progress of nanomedicine can be selected from them (NoP means Nobel Prize):

1913 The targeted drug delivery concept was mentioned first time by P. Ehrlich.

1953 F. Crick, J. Watson and M. Wilkins discovered double-helix structure of DNA. NoP in physiology and medicine 1962.

1971 L. Pauling identified more than 200 components in human breath using chromatography, which became the starting point of a new type of medical diagnosis.

1982 K. Persaud and G. H. Dodd published the concept of an electronic nose as a smart chemical sensor array for odour classification.

1982 N. Seeman developed concept of DNA nanotechnology.

2002 A. Cavalcanti, „pioneer of nanorobotics" et al. invented nanorobot architectures for biomedical applications based on CMOS nanoelectronic circuits.

2005 E. Betzig, S. W. Hell and W. E. Moerner developed (1989 – 2005) two types of super-resolution fluorescence microscope (nanoscope) appropriate for research in biology. NoP in chemistry 2014.

2012 E. M. Charpentier and J. Doudna developed a method of editing the genome. NoP ichemistry 2020.

2016 J.-P. Sauvage, J. F. Stoddart and B. L. Feringa by taking over NoP for chemistry, completed their twenty-year research on the synthesis of molecular machines that has the potential to intervene in medicine.

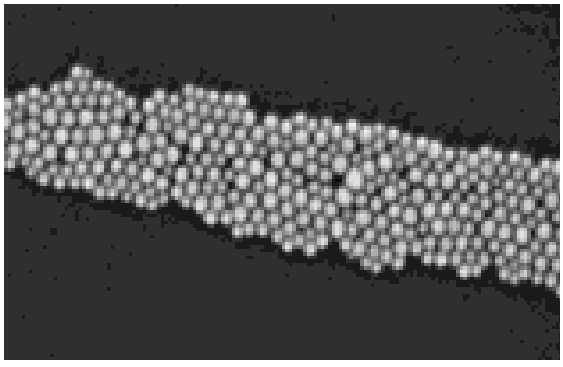
2020 Lipid nanoparticles were used as drug delivery vehicle for theCOVID-19 mRNA vaccines (Pfizer-BioNtech and Moderna). Without the mRNA delivery inside cells the vaccines would not be effective.

It should be also noted that nanomedicine uses a number of inventions, discoveries and solutions from other scientific fields, especially from physics, chemistry, biology and information technology.

3 ANTIBACTERIAL EFFECTS OF NANOMATERIALS

Antimicrobial agents are used in medicine, water disinfection, food packaging, textile industry, etc. Both inorganic and organic nanomaterials (NMs) such as Ag (Figure 2), Au, Cu, Ti, Al_2O_3, NiO, MgO, TiO_2, ZnO, carbon-family members, polystyrene, PLGA, PEG, etc., especially in the form of nanoparticles came to the foreground. We divide them into bactericidal and bacteriostatic, which kill bacteria or slow down their growth, respectively (Hajipour et al. 2012; Mondal 2024). The microbial population must be reduced in hotspots at internal surfaces of the human body, such as catheters or implants, as well as at external surfaces in touch with textiles, medical instruments or surfaces used for food manipulation (Yilmaz et al. 2023).

Figure 2: Ag NPs with a diameter of 15 nm and size dispersion of 10 nm, respectively, synthesized from AgNO3, covered by oleylamine sutfactant and arranged by Langmuir-Schaefer method onto Si substrate.



(Source: Luby 2020)

The importance of antibacterial agents in medicine is enhanced by the fact that bacterial pathogens have gradually evolved countermeasures. The mass production of antibiotics revolutionized medicine but eventually led to the problem of antibiotic resistance (Mondal 2024). High risk is created by multidrug resistant bacteria, which are resistant to three or more classes of antimicrobial drugs.

Antibacterial activity of NMs has stemmed from biophysical interaction – aggregation leading to cell membrane damage. NPs can penetrate the cell wall and eventually kill the bacteria This effect depends on the NP composition, surface area, structure, size, etc. (Tab. 1). With superparamagnetic iron oxide NPs (SPION) covered by gold shell, the process can be amplified by applying alternative magnetic and laser fields, respectively, thus inducing local heating. The activity of Cu NPs depends on the combination of several factors such as temperature, aeration, and low pH. Nitric oxide (NO) releasing NPs are able to inhibit the growth of many antibiotic-resistant bacteria. The accompanying problem is the leakage of NPs into the environment which is a serious threat to beneficial microbes (Hajipour et al. 2012).

The need for antimicrobial NMs is growing fast, it is expected that the global consumption of Ag NPs will reach 800 tons per year by 2025. Therefore, it is timely to focus on green synthesis approach which utilizes naturally sourced plant based starting materials and low-energy process. This approach relies on a safer, cleaner, and more environmentally friendly nanomaterial manufacturing (Sharma 2025). Antibacterial NMs are used also preventively, e.g. in patients with orthopedic implants or for the prevention of nosocomial infections. Ag NPs are widely incorporated in functional textiles such as socks, shoes and bandage (Furxhi 2021).

Various antimicrobial NPs are currently in clinical trials. Forteen of them were published by Mondal (2024).

Table 1: Different NPs and their toxic effects in bacteria.

Bacteria	Bacterial property	NPs	Size, dosage	Toxic action
Staphylococcus aureus gram-positive	Skin, respiratory system infect	Ag-coated and Au-coated SPION	15-20 nm, 25-40 nm, 80 μg/ml both	Biofilm penetration in mag. field
Bacillus subtilis, gram-positive	Non-pathogen protect. endo-spore forming	Al_2O_3	40-70 nm, 20 mg/l	Damage to the bacterial cell wall
Escherichia coli gram-negative	Part of intestinal microflora	NiO	20-30 nm, 20 mg/l	Growth inhibition
Klebsinella pneumoniae gram-negative	Infections of the urinary system	Ag	43 nm, 30 mg/l	Electrostatic adsorption, penetration

(Source: Hajipour et al. 2012, 6–10)

NPs may also help to overcome multidrug resistance of current antibiotics. By means of N&N nanoantibiotics (nAbts) were created. They have many benefits (Sharma 2025):

- Encapsulating drugs in NPs improves their solubility and stability thus increasing their bioavailability and half-life.
- Encapsulating prevents rapid renal clearance and enzymatic hydrolysis, facilitating a long-term therapeutic effect.
- nAbts are capable to circumvent bacterial biofilms, thus bypassing the protective barrier that inhibits conventional antibiotic treatment and deliver the drug directly to the infection site.
- Combining two or more antibiotics often exhibits synergistic effect, enhancing the effectiveness against drug-resistant bacteria.

These structured nanobactericides play a crucial role in boosting the efficiacy of administered antibiotics.

4 TARGETED DRUG DELIVERY

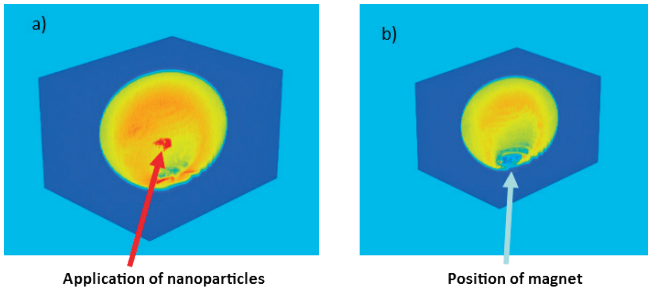
Targeted drug delivery (TDD) belongs to the classic areas of nanomedicine research. Database Scopus has been archiving 117 350 papers on this topic since 1960. Regularly are appearing the review papers, e. g. Li et al. (2023). Research is devoted to the release and absorption of the

drugs, their protection against degradation, in the center of interest are carriers (drug vectors), such as colloids, polymers, monoclonal antibodies and NPs. According to the type of carrier, we recognize physical, chemical and biological targeting. TDD can precisely and effectively deliver drugs to tumor cells or tissues instead of normal cells and tissues. Enhanced permeability and retention (EPR) effect-mediated passive targeting and various types of receptor-mediated active targeting are used. Present TTD is considered to be the 4th generation of drug delivery systems. TDD concept was mentioned as early as 1913 by P. Ehrlich, laureate of the Nobel Prize in medicine. He reasoned that "if a compound could be made that will selectively target a diseased organ, then drug could be delivered along with that agent". His term for this therapeutic agent was *magic bullet* (Zauberkugel). Today this approach, so called *Trajan horse therapy*, together with tailored drug design for individual patients, fulfills the content of the precision medicine.

Within the scope of this work it is possible to discuss the TTD only briefly. We will mention at least the topics studied in SAS. Physicists are interested in NPs drug carriers which include also magnetic nanoparticles, such as Fe_2O_3, which, after functionalization with drugs, are navigated to their destination by external magnetic field (Figure 3). MoS_2 nanosheets bio-conjugated with an antibody driven recognition element belong here as well (Kálosi et al. 2020).

But nanomedicine also includes magnetic nanoparticles for other diagnostic/imaging processes and therapeutic methods, especially hyperthermia (Hedayatnasab 2017).

Figure 3: Localization of magnetic NPs (left, black arrow) with a focused magnet (right, white arrow) in an experiment using the model of hen egg.



(Source: P. Kopčanský, Inst. Exp. Phys. SAS, Košice)

5 MOLECULAR HYDROGEN IN PREVENTIVE AND THERAPEUTIC APPLICATIONS

Oxidative stress is one of the causes of many diseases, including cancer. One of pioneering papers by Ohsawa et al. (2007) (team led by S. Ohta) has shown that molecular hydrogen (H_2) has potential as an antioxidant in preventive and therapeutic medicine. H_2 is a selective scavenger of hydroxyl radicals -OH, the most cytotoxic among the reactive oxygen species (ROS). Moreover, H_2 does not react with other ROS which have important physiological roles. At SAS J. Slezak's group belongs to the leaders in this area (Kura et al. 2024).

Molecular hydrogen is the smallest molecule with a covalent radius of 31 pm. Small molecules penetrate the cellular membrane and rapidly diffuse into organelles. Therefore, H_2 can be supplied to the body through multiple, mostly non-invasive routes of administration such as oral intake of free H_2 containing water or bathing in it, inhalation of H_2 gas, but also intravenous infusion of H_2-saline. Hydrogen positively influences the function of all the main organs of the human body such as the brain, lungs, liver, kidney, etc.

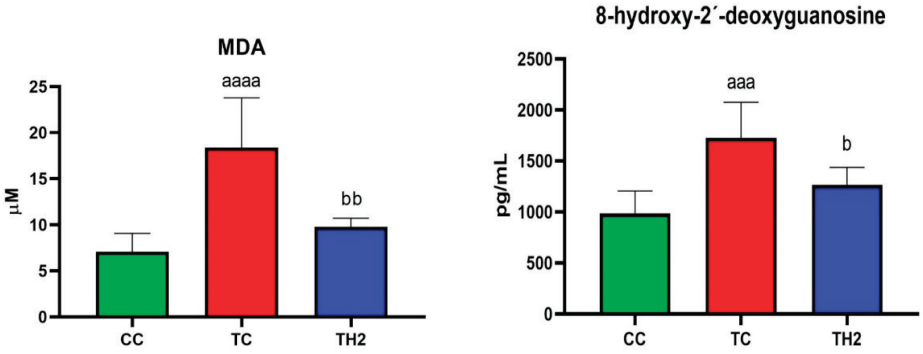
As an example, we will show how hydrogen reduces oxidative stress and improves results of simulated porcine heart transplantation (hearth is completely isolated from the body by occluding and cannulating all big veins and arteries, but it remains in the chest stored in a crushed ice of saline solution at 4 °C) (Kura et al. 2024). Experiment was performed with pigs 4 – 5 months old connected to the extracorporeal circulation. Duration of experiment was 3 h (standard time of transplantation). H_2 was provided also during 60 min period of reperfusion.

Three pig groups were as follows:

1. Group with transplantation – TC,
2. Group with transplantation with hydrogen rich air (4 % of H_2) in anesthesia – TH_2,
3. Control group – CC.

When the hearth after transplantation reached standard pressure and pulse, blood and tissue samples were analyzed for 16 types of markers, among them inflammatory and oxidative stress damage markers. We will show two results (Figure 4).

Figure 4: Two oxidative damage markers: malondialdehyde (MDA, lipid peroxidation) and 8-hydroxy-2'-deoxyguanosine (biomarker of oxidative DNA damage) show significant reduction after hydrogen treatment in TH2 group in comparison with TC group.



(Source: J. Slezak, Center of Exp. Medicine, Inst. of Heart Res. SAS, Bratislava).

In conclusion, the administering of H_2 during simulated transplantation significantly decreased all relevant markers of ischemia, lipid peroxidation and inflammation.

N&N is moving into the H_2 therapy in the field of technical support. This includes also the use of graphene or NP sensors of hydrogen, which is explosive when its concentration in air is over 4% (Luby 2016, 122). Another application are the safe and comfortable hydrogen storage media from graphene doped by Li, Al, Zr with regulated release, e. g. Yadav et al. (2017). Nevertheless, the most sophisticated "nano-contributions" to H_2 therapy are making use of local generation of hydrogen to increase the efficiency of its action: Chen et al. (2022) described the photocatalytic therapy of diabetic wound by sustainable hydrogen local generation. H_2 was incorporated in TiO_2 nanorods and released by visible light (xenon lamp 400 – 700 nm). Satisfactory diabetic wound healing was reported. An overview of the other five treatments (Alzheimer's disease, cervical and breast cancer, cancer drug resistance, male fertility and colon carcinoma) is given in Luby (2024).

6 CONCLUSION

Nanomedicine and its applications have been progressing for almost 30 years. The global nanomedicine market reached around 209 billion USD in 2024. In this paper it was shown that antimicrobial particles are very important from the point of view of coping with antibiotic resistance, that targeted drug delivery which came out of oncology is gradually permeating many fields of medicine, and that the use of molecular hydrogen in the effective prevention and therapy of many diseases has already been confirmed on a broad basis. Further, we selected ten milestones of medicine, four of them were awarded the Nobel Prize. We pointed at some possibilities of increasing nanosafety, such as the use of green technologies, preference for non-invasive breath diagnostic methods, etc. The knowledge gaps and future research needs are identified in Zhang (2020). We expect further development in the field of ultra-precise disease treatment. Particular challenges are represented by applications of nanobots or smart pills equipped with nanoscale sensors and also in the field of prevention.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

IMPROVING QUALITY OF LIFE IN OLD AGE WITH OXYGEN-OZONE THERAPY

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ABSTRACT

Oxygen-ozone therapy is an emerging medical intervention with expanding applications in clinical and biomedical contexts. This study explores its potential to address age-related disabling conditions by modulating key biological pathways. The central research question investigates how ozone therapy influences immune regulation and tissue repair mechanisms relevant to degenerative and inflammatory diseases. Using a review-based analytical approach, we examine the role of ozone in activating the Nrf2/HO-1/CO pathway, inhibiting NF-κB, shifting macrophage polarization from M1 to M2, enhancing Treg cell populations (CD25+Foxp3+), and facilitating tissue remodelling. These immunomodulatory effects suggest that oxygen-ozone therapy may complement conventional pharmacological treatments, contributing to a safer and more effective strategy for healthy aging.

Keywords: *Ozone therapy, Immune modulation, Healthy aging, Inflammation, Tissue repair*

1 INTRODUCTION

As life expectancy continues to rise globally, societies are grappling with the challenges posed by aging populations. Chronic diseases, functional impairments, and the progressive decline in physiological resilience characterize the aging process, often leading to reduced quality of life. The pursuit of therapies that promote "healthy aging"—defined as aging with minimal disability, maintained physical and mental capacity, and continued participation in social activities—has become a central goal in biomedical research and healthcare (Riva et al. 2014; Ricciardi et al. 2014).

Oxygen-ozone therapy, a complementary medical practice, has garnered attention for its potential to address these challenges (Scassellati et al. 2020). This therapeutic approach harnesses the unique properties of ozone to modulate biological systems, enhance immune responses, and support tissue repair. Through the controlled application of ozone, patients may experience improvements in chronic conditions, such as musculoskeletal disorders, autoimmune diseases, and neurodegenerative conditions (Chirumbolo et al. 2024a).

This paper explores the biochemical mechanisms of oxygen-ozone therapy, its clinical applications in aging populations, and the evidence supporting its efficacy. Furthermore, it discusses the challenges and ethical considerations of this emerging therapy while proposing strategies for future development and integration into standard medical care.

2 PURPOSE AND GOALS

The purpose of this Review is to highlight the recent insightful evidence regarding the use of ozone therapy in improving quality of life in the elderly.

3 THE BIOCHEMICAL MECHANISMS OF OXYGEN-OZONE THERAPY

Ozone as a Controlled Oxidative Stressor

Ozone is a strong oxidant that can be toxic at high concentrations but exhibits therapeutic effects when administered within a hormetic range (Bocci 2004; Bocci et al. 2011, Chirumbolo et al. 2023a). Hormesis describes a biphasic dose-response relationship where low doses of a stressor stimulate adaptive responses, while high doses are detrimental. In the context of oxygen-ozone therapy, mild oxidative stress induced by ozone activates signaling pathways that restore redox balance and cellular homeostasis.

Ozone dissolves into biological fluids to form reactive oxygen species (ROS) and ozonides, which act as signaling molecules. This process stimulates antioxidant defense, including the production of glutathione (GSH), superoxide dismutase (SOD), haeme oxygenase (HO-1) and catalase (CAT). These molecules neutralize excess ROS, preventing oxidative damage while maintaining cellular function.

The Nrf2/HO-1/CO Pathway

A key mechanism by which ozone exerts its therapeutic effects is through the activation of the Nrf2/HO-1/CO pathway. Nrf2 is a transcription factor that regulates the expression of genes involved in antioxidant responses, inflammation control, and cellular repair. Ozone therapy enhances Nrf2 activation, leading to the upregulation of haeme oxygenase-1 (HO-1) and the production of carbon monoxide (CO), both of which play anti-inflammatory and cytoprotective roles (Chirumbolo et al. 2023a; Chirumbolo et al. 2023b; Franzini et al. 2023).

Immune Modulation and Autoimmunity

Ozone therapy modulates immune responses by promoting a shift from pro-inflammatory to anti-inflammatory states. This is achieved by polarizing macrophages from the M1 (pro-inflammatory) phenotype to the M2 (anti-inflammatory) phenotype. Additionally, ozone enhances the activity of regulatory T cells (Tregs), which suppress autoimmune responses and maintain immune tolerance. These mechanisms are particularly beneficial in autoimmune conditions such as rheumatoid arthritis.

Adaptive Chaos and Biological Complexity

Biological systems are inherently complex and exhibit adaptive chaos—a state of controlled, dynamic fluctuation that allows flexibility and resilience. Aging and chronic diseases often disrupt this adaptive chaos, leading to rigid or disorganized system behavior. Ozone therapy reintroduces adaptive chaos by inducing oscillatory dynamics in redox balance and immune responses. This restores the system's ability to respond effectively to internal and external stimuli.

4 CLINICAL APPLICATIONS OF OXYGEN-OZONE THERAPY IN AGING

Musculoskeletal Disorders

Musculoskeletal conditions such as osteoarthritis and rheumatoid arthritis are common among the elderly and significantly impair mobility and quality of life. Ozone therapy has demonstrated efficacy in alleviating pain, reducing inflammation, and improving joint function. Studies have shown that intra-articular ozone injections reduce oxidative stress markers and pro-inflammatory cytokines while enhancing cartilage repair (Paoloni et al. 2009).

In a clinical trial, elderly patients with rheumatoid arthritis treated with ozone therapy exhibited significant improvements in disease activity scores and reductions in pain perception compared to those receiving standard pharmacological treatment alone.

Neurodegenerative Diseases

Neurodegenerative conditions, including Alzheimer's and Parkinson's diseases, are characterized by oxidative stress and chronic neuroinflammation. Ozone therapy mitigates these processes by enhancing mitochondrial function and reducing ROS-induced neuronal damage. Preclinical studies suggest that ozone therapy promotes neurogenesis and protects against cognitive decline.

Furthermore, ozone's ability to modulate the Nrf2 pathway may help reduce the accumulation of misfolded proteins, a hallmark of neurodegenerative diseases.

Cardiovascular and Metabolic Health

Aging is associated with an increased risk of cardiovascular and metabolic diseases, including hypertension, atherosclerosis, and type 2 diabetes. Ozone therapy improves vascular function by regulating vasoactive mediators such as thromboxane A2 (TXA2) and prostacyclin. This reduces thrombosis risk and enhances blood flow, benefiting patients with cardiovascular conditions.

In metabolic health, ozone therapy enhances insulin sensitivity and lipid metabolism, supporting glycemic control in diabetic patients.

Chronic Respiratory Conditions

Elderly individuals with respiratory diseases, such as chronic obstructive pulmonary disease (COPD) and asthma, benefit from ozone's anti-inflammatory and vasodilatory effects. By increasing nitric oxide (NO) levels, ozone therapy improves airway function and reduces bronchial inflammation.

5 CLINICAL EVIDENCE SUPPORTING OZONE THERAPY

Randomized Controlled Trials

A study involving 45 elderly patients with rheumatoid arthritis and comorbidities demonstrated the efficacy of ozone therapy in reducing oxidative stress and improving clinical outcomes. Patients treated with medical ozone showed significant improvements in redox balance, pain scores, and disability indices compared to controls.

Similarly, a study on bronchial asthma patients revealed that ozone therapy decreased TXA2 levels and improved prostacyclin production, leading to better respiratory function and reduced inflammation (León Fernández et al. 2022; Paoloni et al. 2009).

Case Studies and Observational Data

Case studies highlight the broad applicability of ozone therapy in managing age-related conditions. For instance, patients with diabetic foot ulcers treated with ozonated oil experienced accelerated wound healing and reduced infection rates. These findings underscore the antimicrobial and tissue-repair properties of ozone.

6 CHALLENGES AND ETHICAL CONSIDERATIONS

Misuse and Overcommercialization

The increasing popularity of ozone therapy has led to its misuse in non-medical settings, such as wellness centers. These practices often lack scientific rigor and pose safety risks. To preserve the credibility of ozone therapy, it is crucial to establish strict regulations and ensure that only qualified medical professionals administer treatments.

Standardization and Training

The efficacy of ozone therapy depends on precise dosing and administration. Variability in protocols can result in inconsistent outcomes or adverse effects. Developing standardized guidelines and training programs for healthcare providers is essential to ensure the safe and effective use of ozone therapy.

Public Perception and Education

Misinformation about ozone therapy, often perpetuated by non-professional practitioners, undermines public trust. Educational initiatives targeting healthcare professionals and the general public are needed to communicate the scientific basis and therapeutic potential of ozone therapy.

7 FUTURE DIRECTIONS

Advanced Research

Further research is needed to elucidate the molecular mechanisms of ozone therapy and optimize its applications. Long-term studies should investigate its impact on aging biomarkers, cognitive decline, and disease progression.

8 ADAPTIVE CHAOS IN BIOLOGICAL SYSTEMS

Aging disrupts the adaptive chaos—a state of controlled biological complexity—that underpins cellular resilience. Ozone therapy reintroduces adaptive chaos, enhancing the body's ability to respond to internal and external stressors. This is achieved by modulating oscillatory pathways involving ROS and antioxidant dynamics. By promoting self-organization within biological systems, ozone supports a return to homeostasis, a cornerstone of healthy aging (Chirumbolo et al. 2024b).

Integration into Mainstream Medicine

Integrating ozone therapy into conventional medical practices requires collaboration among researchers, clinicians, and policymakers. Demonstrating its cost-effectiveness and compatibility with existing treatments will facilitate its adoption.

Personalized Ozone Therapy

Advances in biomarker analysis and diagnostic tools could enable personalized ozone therapy tailored to individual patients' genetic, metabolic, and physiological profiles. This approach would enhance efficacy and minimize risks.

9 CONCLUSION

Oxygen-ozone therapy represents a promising intervention for addressing the challenges of aging. By modulating oxidative stress, enhancing immune function, and supporting adaptive chaos, ozone therapy restores resilience and promotes healthy aging. Clinical evidence highlights its efficacy in managing musculoskeletal, neurodegenerative, cardiovascular, and respiratory conditions, underscoring its potential as a complementary therapy.

However, addressing challenges related to misuse, standardization, and public perception is critical to unlocking its full potential. As research progresses and guidelines are refined, oxygen-ozone therapy could become an integral part of geriatric care, enabling individuals to age with dignity, vitality, and improved quality of life.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

ERGONOMICS FOR WORK-LIFE BALANCE: EVIDENCE AND INSIGHTS

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ABSTRACT

Introduction: It is widely recognised that ergonomics, in designing workplaces to suit human capabilities, eliminates discomfort and ensures safety; it also increases productivity and reduces the causes of absenteeism and presenteeism. Therefore, our aim was to assess how ergonomics supports work-life balance by improving physical health, psychological well-being, and work performance in office, industrial, and remote settings.

Methods: We conducted a structured secondary analysis of seven case studies from different industries and countries. We reviewed sources for relevance and completeness, extracted data using a standard form covering context, objectives, methods, outcomes and limitations, and used thematic analysis to compare the impact of ergonomic interventions. We also considered the specific needs of remote and hybrid work.

Results: In all cases, ergonomic interventions reduced musculoskeletal problems and injury risk, and reduced absenteeism or presenteeism. Reported improvements included greater comfort, better task performance, and higher job satisfaction. Office training reduced posture-related strain and stress. Participatory ergonomics increased employee acceptance as well as the quality and accuracy of the solutions. Targeted changes for employees with disabilities improved work ability and integration. In heavy industry, the programmes reduced accidents at work and days lost. Studies in workplaces with long hours or shift work have shown that basic ergonomic rules combined with fair scheduling help protect sleep, mood, and family time.

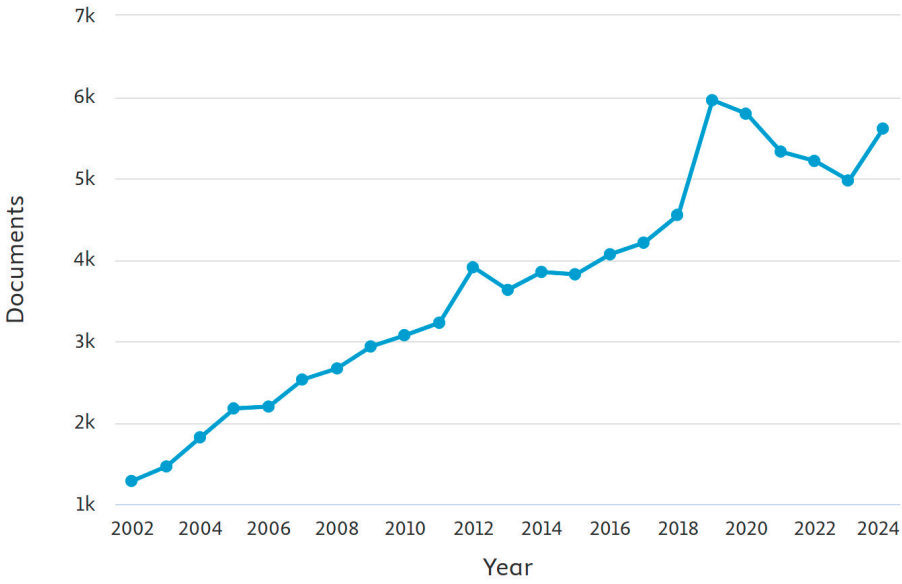
Discussion: Ergonomics is not just a productivity tool, but a key health measure that supports sustainable work-life balance. Managers should put together a basic package: risk assessment, rapid workplace corrections, employee training, and participative planning, with regular review. Clear guidance and necessary equipment are needed for remote and mixed workplaces. Future studies should track long-term outcomes, consider the cultural context, and test digital assessment tools.

Keywords: *Ergonomics, Work-life balance, Workplace design, Musculoskeletal disorders, Employee well-being*

1 INTRODUCTION

Ergonomics adapts the workplace to improve comfort, safety and performance (Balantič et al. 2016). This is particularly important in areas where there is a lot of sitting, such as IT and office jobs. By reducing physical strain and health risks, these measures also increase efficiency and job satisfaction (Nizami et al. 2017). Workstations with adjustable desks, chairs that support the lower back and monitors at the right height reduce muscle and joint problems and lower associated costs (Salawati et al. 2023). They also increase concentration and reduce fatigue during sedentary tasks (Naber et al. 2021). Implementing ergonomic ideas can reduce absenteeism or presenteeism and staff turnover and shows how it impacts organizational success (Mairaj et al. 2024). Recognising the link between ergonomics and productivity, companies are evolving their practices to meet the diverse needs of today's workforce. Figure 1 shows the growth trend in ergonomics research over the years.

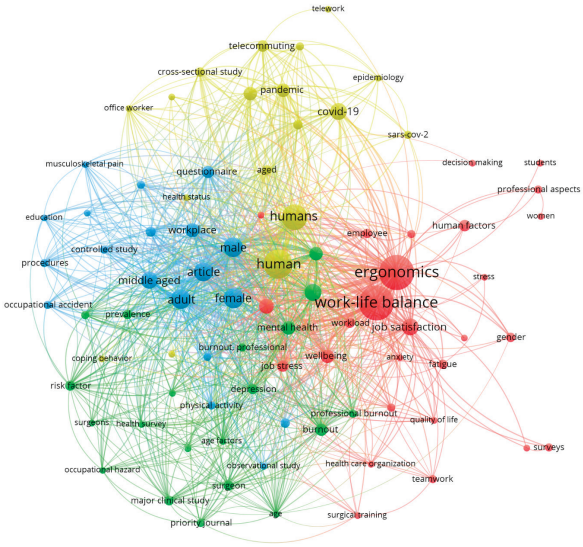
Figure 1: Number of documents from Scopus database for "ergonomics" over the last 23 years



(Source: Scopus, 2025)

Ambesange et al. (2024) report that ergonomic measures support work-life balance (WLB) and ensure comfort, safety and performance of workers. These measures reduce muscle and joint discomfort, increase job satisfaction and improve outcomes while meeting the demands of modern working environments, including remote working (Jones et al. 2023). At the same time, remote working can blur the boundary between workplace and home, increasing stress and requiring ergonomic changes to avoid physical and mental discomfort (Palumbo 2020). Flexible working hours promote well-being when they are fair, but extended or odd shifts - such as nights or weekends - can jeopardise health and reduce life satisfaction (Brauner et al. 2019). In healthcare, backward shift rotations impact sleep and family life, demonstrating the need for tailored ergonomic measures in shift-based roles (Shiffer et al. 2018). Authors suggest that organizations should combine ergonomic rules, flexible scheduling and mental health support to design caring, sustainable and effective workplaces so that employees can maintain a balance both at work and at home (Ambesange et al. 2024). That is why the term WLB started gaining in popularity in the 1980s and is even more important in today's fast evolving digital environment. Figure 2 shows us the visualization and interconnectedness of ergonomics and WLB made with VOSviewer (Van Eck and Waltman, 2023). As we can see, the nodes are very close together and in the same colour, which tells us that the aforementioned fields overlap greatly.

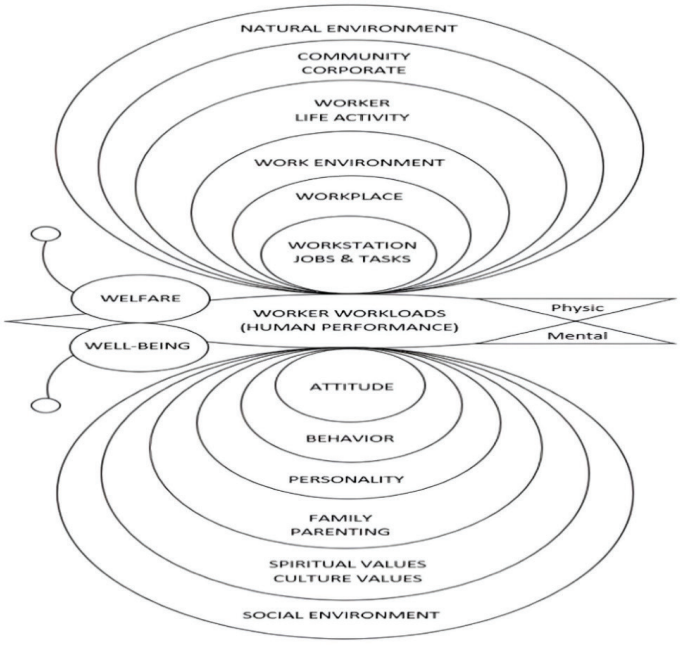
Figure 2: Visualization of keywords for ergonomics and WLB



(Source: Authors' own visualization, 2025)

Figure 3 shows how WLB depends on both physical and mental factors. The physical side covers task design, the workstation, the workplace, and the wider setting; the mental side covers attitude, behaviour, and personality. Workload and performance sit in the middle as the link between the two, while welfare and well-being are the outcomes. When job demands rise or support falls, balance worsens; when the job fits the person and support is present, balance improves. Personality shapes how people respond to the same conditions, which is why the same task can affect workers differently (Marhaendra, 2023).

Figure 3: The effect of worker's personality on WLB



(Source: Marhaendra, 2023)

2 PURPOSE AND GOALS

The purpose of this paper is to assess how ergonomic measures support WLB by reducing physical strain and mental stress across office, industrial, and remote or hybrid settings. To achieve this, the study synthesises evidence from seven case studies, classifies intervention types such as workstation adjustments, task and layout redesign, worker training, participatory ergonomics, assistive adaptations, and scheduling practices, and compares their effects across different contexts. The analysis also identifies minimum requirements for safe and effective home-office work and distils a practical set of elements that managers can apply to support WLB. In addition, the study addresses which ergonomic actions most effectively reduce musculoskeletal problems while improving well-being, whether participatory ergonomics leads to greater adoption and outcomes, what minimum measures are needed in remote roles, and how effects differ across sectors and worker groups. While the paper provides structured insights, its scope is limited to secondary analysis of published case studies, meaning that findings highlight recurring patterns rather than precise effect sizes.

3 METHODS

This study is based on a secondary analysis of published case studies examining the relationship between ergonomics and WLB. Case studies were selected using two main criteria: relevance, meaning that ergonomics was a central focus and outcomes were explicitly linked to WLB; and completeness, requiring that studies reported context, methods, and results in sufficient detail for comparison. The search used combinations of the terms "ergonomics", "workplace design", and "work-life balance" in major academic databases, such as Web of Science and Scopus.

For each case, a structured form was applied to extract information on research context, aims, methodology, outcomes, and reported limitations. Thematic analysis was then used to identify recurring patterns and to compare findings across office, industrial, and remote or hybrid settings.

This approach has limitations. Only published and accessible case studies were included, which may introduce publication bias and exclude grey literature or negative findings. The quality and design of the original studies varied, meaning that results should be interpreted as indicative patterns rather than precise effect estimates. Because this study is based on secondary sources, it cannot control for confounding factors or directly measure outcomes. Nonetheless, the method provides a systematic overview of how ergonomics influences WLB across different environments.

4 RESULTS

The review covered seven case studies from Asia, Europe, and South America, spanning office, industrial, academic, and remote work settings. Despite contextual differences, several recurring patterns emerged.

The first study examines the relationship between WLB, work injuries and musculoskeletal pain in Korean workers. Using data from more than 27,000 people, it shows that a poor WLB is associated with a 37% higher likelihood of workplace injury and a 14% higher risk of musculoskeletal pain. The main factors include long working hours, workplace hazards and psychological stress. Poor WLB was more common among certain groups, particularly older employees, blue-collar workers and people in physically demanding jobs. These findings emphasise the importance of workplace rules and better facilities to improve WLB and reduce health risks for employees (An et al. 2020).

The second study examines how workplace ergonomics directly impacts the quality of work life of academics in Indian higher education institutions. Academicians often face musculoskeletal problems due to long hours of sitting, research, lectures, administrative work, computer use, low physical activity, prolonged standing, and career pressure. The study indicates that appropriate ergonomic measures improve the health of employees and their work performance. The study focuses on the academic sector and strongly emphasises the need for ergonomic planning to significantly increase job satisfaction and the overall value of teachers' work (Agarwal et al. 2023).

The research paper by Gopinathan and Raman (2015) examines how ergonomic standards help to improve the WLB of information and communications technology (ICT) employees in Malaysia. It refers to the expanding ICT sector in Malaysia and the strain of long working hours and reliance on technology in a 24/7 working environment. It uses a numerical method to see how well-designed tools and systems can significantly reduce stress, significantly improve performance and facilitate remote working. It looks at how information systems quality, ergonomic attitudes and employee well-being are related. The findings provide helpful tips for ICT policy and sustainable workforce growth that enables a better WLB.

Sohrabi and Babamiri (2022) conducted a study with Iranian office workers that has shown that ergonomic training significantly reduces workers' complaints about joints and muscles and considerably improves the general quality of life. By addressing both physical and psychological factors associated with common office jobs, the programme provided workers with the critical skills they needed to effectively deal with hazards such as poor posture, repetitive movements and work stress. These targeted interventions not only reduced physical pain, but also contributed to a more positive, health-orientated working environment. The study strongly emphasises why offices should introduce structured ergonomics training to address health hazards at an early stage and significantly increase the overall well-being of employees.

A pilot ergonomic programme at a Brazilian university demonstrates how targeted solutions can support employees with physical disabilities. The programme made tailored changes to workstations and provided physiotherapy, focusing on the needs of individuals to create a more inclusive environment. These efforts resulted in a significant improvement in quality of life and work ability, proving that ergonomic methods can increase both comfort and productivity. By addressing the challenges faced by employees with disabilities, the programme not only improved their ability to work effectively but also highlighted the need for accessibility in workplace design. This example emphasises the key role of ergonomics in promoting equality and supporting all employees at work (de Almeida et al. 2019).

An ergonomics programme in a shipbuilding company in South Korea has shown how important it is to focus on ergonomics in the workplace. It increased productivity, lowered the accident rate and reduced the number of lost working days, demonstrating the direct link between employee well-being and operational performance. By eliminating industry-specific issues such as awkward postures, repetitive tasks and heavy lifting, the programme reduced the risk of injury and musculoskeletal disorders. This case demonstrates that investing in ergonomics can improve safety, job satisfaction and overall performance while reducing costs associated with absenteeism and workplace incidents. These findings suggest that ergonomic measures can help create a safer, healthier and more productive industrial work environment (Pyo and Jeong 2007).

Our final study by Khani Jazani et al. (2013) researched a participatory ergonomics programme in a steel company in Iran and demonstrated the benefits of involving workers in ergonomic decision-making. This approach increased employee satisfaction, improved safety and the overall quality of working life. By soliciting direct input from employees to address specific challenges, the programme reduced physical strain and discomfort, creating a healthier and more enjoyable workplace. Engaging employees also gave them a sense of ownership and participation, which enhanced the impact of the programme. This progress not only helped individuals but also led to a more balanced and sustainable work environment, demonstrating the value of participatory ergonomics in industrial workplaces.

5 DISCUSSION

In seven case studies in office, industrial, academic, and remote locations, ergonomic measures were associated with positive outcomes. Most cases reported fewer musculoskeletal complaints and reduced risk of injury following workplace redesign, task/layout redesign, and brief training. Several programmes also reported fewer days of absence or presenteeism, as well as higher job satisfaction, concentration and task performance. In industry, participative approaches have reduced stress and improved safety. A Brazilian pilot project showed that customised adaptations for workers with disabilities improved comfort, work ability, and integration. Evidence

from Korea and other shift-based jobs showed that poor WLB increased the risk of injury and pain. In remote and hybrid work, poor home office set-up caused fatigue and stress, while simple guidance and minimal equipment solved most problems.

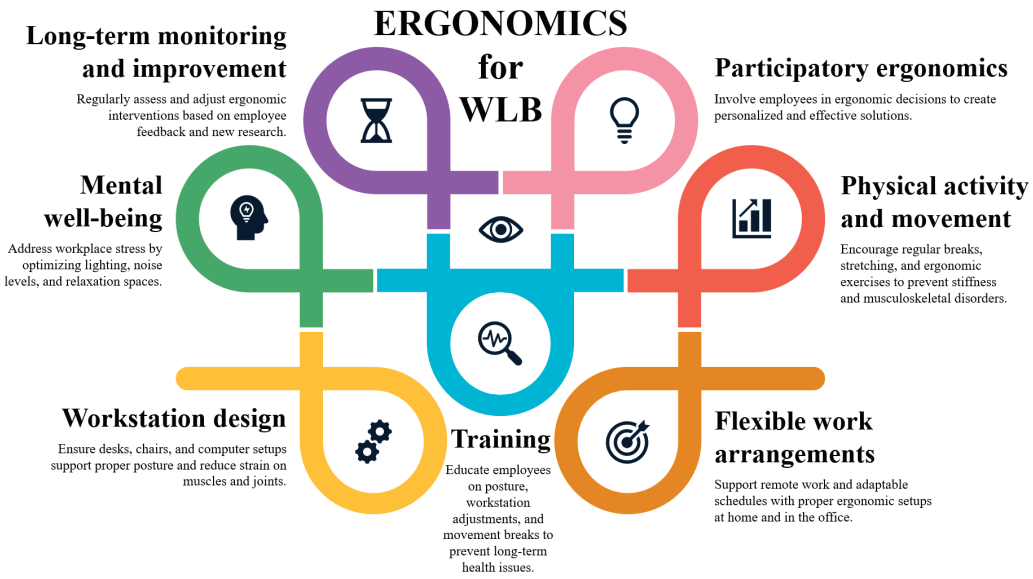
Ergonomic measures address both the physical and mental side of balance, but the impact depends on context and execution. Worker participation increased acceptance and impact compared to top-down programmes. Customised interventions - for disabled employees or remote workers - were stronger because they targeted specific needs. Overall, a core package of regular risk checks, rapid workplace corrections, short practical training, sessions and participatory planning reduced strain and stress in all areas and promoted well-being and sustainable performance.

Hereinafter, we summarise each case concisely, stating the ergonomic mechanism they used and practical consequence. In this way, the analysis remains streamlined and links the findings to a clear theory:

- An et al. (2020) found that poor WLB was associated with a 37% higher likelihood of injury and a 14% higher risk of musculoskeletal pain in more than 27,000 workers. They found that high demand with low recovery and unsafe workload can be solved with ergonomic controls and fair scheduling to restore recovery time. Similar evidence from Dembe et al. (2005) shows that long working hours and overtime significantly increase occupational injury risk.
- Agarwal et al. (2023) claim that ergonomic planning for employees who sit and stand for long periods improved the quality of work life. The mechanism is better adaptation of the person to the workstation and reduced static load - this was done with the use of adjustable furniture and short movement breaks in teaching and research spaces.
- In the Malaysian ICT sector, establishing ergonomics standards and improving system quality have reduced stress and improved performance, even when working remotely. The way forward is lower physical and cognitive strain with a clearer task flow in a 24/7 environment (Gopinathan and Raman, 2015). These findings support the work of Palumbo (2020), who stresses the need for ergonomic measures to maintain WLB in technologically driven sectors.
- Brief ergonomics training reduced musculoskeletal complaints and work stress and increased the quality of working life of Iranian office workers. Skills learned, that were later used as a resource include workers adapting their posture, layout, and work routines themselves, which increases control and reduces demands. (Sohrabi and Babamiri, 2022). This is in line with Ambesange et al. (2024), who point to the urgency of ergonomic interventions in virtual work environments to avoid mental and physical stress.
- De Almeida et al. (2019) customised workstations with physiotherapy and improved comfort, work ability, and integration. Their mechanism is a strong person-environment adjustment that reduces the effort per task. It also allows reasonable adjustments to be part of the basic package.
- Since shipbuilding is a part of heavy industry, redesigning routine tasks and reducing biomechanical stress must be prioritised. The company in the case study by Pyo and Jeong (2007) introduced an ergonomics programme which reduced accidents and lost days and increased productivity.
- Finally, Khani Jazani et al. (2013) suggest that participatory ergonomics increases satisfaction, safety, and quality of working life. Employee involvement increases control and social support, which promotes acceptance and keeps changes in everyday workers' practice. This aligns with findings from a systematic review by Rivilis et al. (2008), which reported that participatory ergonomic programmes reduce musculoskeletal symptoms and improve workplace health outcomes.

Taken together the evidence suggests that organizations must prioritize ergonomic interventions as part of their workplace policies to enhance employee well-being and productivity. Tailored ergonomic programs, participatory approaches, and training initiatives should become standard practices across industries. Furthermore, remote work environments require a focused application of ergonomic principles to prevent physical and psychological stress. Policymakers and business leaders should integrate these findings into workplace design and health strategies. The figure below highlights seven key factors essential for creating an ergonomic workplace that supports WLB (Figure 4).

Figure 4: Key elements of workplace ergonomics for WLB.



(Source: Authors' own visualization, 2025)

6 CONCLUSION

Our study concludes that ergonomics play a large role in developing a balanced work-life environment through reducing work-related musculoskeletal disorders and productivity improvement. Ergonomic interventions have a strong impact in improving workers' welfare, reducing absenteeism, and creating safer and more efficient work environments. All these go towards confirming the necessity for companies in any field to integrate ergonomics into the workplace.

Some of the possible practices include participatory ergonomics - where workers take part in decision-making, individual interventions - that work well for disabled workers, and planned training programs, where workers can find out about different ergonomic principles and put them to test. There is a need for ergonomic development in working environments even when working remotely, in order to mitigate the unhealthy consequences of poorly designed home offices.

However, gaps in knowing long-term ergonomics intervention consequences in a range of work and cultural environments still exist. In the future, studies should explore in detail new emerging technology, such as AI workplace evaluations or analyses with the help of motion tracking sensors, and their role in further simplifying ergonomics interventions for even increased efficiency and effectiveness. Closing such gaps will allow for creating a comprehensive approach for enhancing workers' health and overall WLB.

This paper makes three main contributions. First, it synthesises seven case studies across sectors and shows that ergonomic actions reduce musculoskeletal problems, improve performance and satisfaction, and cut lost workdays. Second, it links specific interventions, such as workstation fixes, layout changes, worker training, participatory approaches, and tailored support, to the outcomes they affect. Third, it sets minimum home-office requirements that help prevent fatigue and stress. The study also has limits: it relies on secondary case reports of varied quality; outcomes and measures differ, so pooled effect sizes are not possible; publication bias may be present; cost data are scarce; and results may not generalise to every setting. These points suggest clear next steps: test the core package with stronger comparative designs, track long-term effects, include diverse sectors and cultures, and add cost-effectiveness and simple digital assessment tools.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

EU SPORTS PUBLIC POLICIES AND THEIR EFFECTIVENESS IN PROMOTING A HEALTHY LIFESTYLE

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ABSTRACT

Promoting sports and physical activity among the population constitutes a foundational objective of public policy in the European Union's sports sector. However, findings from the 2022 Eurobarometer 525 survey on Sport and Physical Activity reveal that 45% of EU citizens do not participate in sports, marking a 2% increase since 2013. Among individuals aged 15–24, 27% report complete inactivity. This article aims to evaluate the effectiveness of EU sports-related public policies in achieving their primary goal: fostering a healthier lifestyle through increased physical activity. A secondary objective is to assess whether public investment in sports correlates with higher participation rates. Utilizing regression analysis and secondary empirical data, the study demonstrates that current sports policies across EU member states have limited success in promoting physical activity. These findings underscore the need for enhanced efficiency in both financial resource allocation and policy implementation. Crucially, the study highlights the absence of systematic audits and the lack of clearly defined, measurable benchmarks for evaluating policy outcomes. Establishing regular evaluations and performance indicators is essential for improving the impact of sports-related public initiatives.

Keywords: *Effectiveness, Healthy lifestyle, Sports activity, Sports' public policies*

1 INTRODUCTION

The word sport has its roots in the Latin word "disportare" which can be loosely translated as "to have fun". However, sport is not only a means of entertainment for the broad masses of the population, it is also a physical and mental activity with a measurable impact on the health of the population and also, surprisingly for many, an impact on world and national economies. Sport and its economic impacts are still a sufficiently unexplored area. Fitzel (2006) states that the economics of sport is becoming an increasingly attractive and respected industry with the significant interest of the professional public in the outputs of the given area.

According to the study "Study on the Economic Impact of Sport through Sport Satellite Accounts" from 2018 (European Commission, 2018), sport contributes up to 2.12% of GDP and 2.72% of total employment within the European Union.

In this article, we focus on the success of the European public policies in the field of sport/ public finance expenditures on the level of sports activity, or inactivity of the population. The long-term declining sports activity of the population of the European Union countries was the main reason for emphasizing the support of a healthy lifestyle of the population within strategic documents for the field of sport (e.g. White Paper on Sport, Physical Activity Guidelines - Recommended Policy Actions in Support of Health-Enhancing Physical Activity). According to the Eurobarometer 525 Sport and Physical Activity study from 2022, 45% of the population does not engage in sports at all, which represents an increase of 2% compared to 2013, while in the category of residents aged 15-24 years, 27% of the population does not engage in sports at all, while this % is growing with the increasing number of years of individuals (European Commission, 2022).

As part of the selection of indicators for comparative analysis and the subsequent formulation of research question, we assumed that countries with a higher volume of public investments in sports have a higher proportion of sports-active population. The basis for the theoretical basis of the article was professional monographs and professional articles in domestic and foreign peer-reviewed journals. The sources of secondary data for the implemented research part were mainly studies and expertise prepared by the European Commission and sources of macroeconomic statistical databases EUROSTAT.

The issue of mechanisms for allocation public resources in sport was addressed by several authors as Andreff et al. (2006; 2009); De Carlos, Alen and Perez-Gonzales (2017); Downward et al. (2009; 2019); Kassale et al. (2018); Lowther et al. (2016); Mitchell et al. (2012); Groothuis and Rotthoff (2016); De Bosscher, Shibli and Weber (2019). The issue was also addressed by Czech and Slovak authors such as Pavlík and De Vries (2014); Nemec, Nemec and Pavlík (2014). The main issues of allocation of public resources identified by the authors are:

1. Identification and appreciation of the value of sport for the public.
2. Efficiency of the use of public funds in sport.
3. Fair and transparent distribution of public funds based on achieved results in sport.
4. High dependence of sports organisations on public funds

2 BASIC ORGANIZATIONAL DEFINITION OF SPORT

Sport is a relatively broad concept with the already mentioned multidisciplinary reach. We recognized 2 main levels of sport, i.e. sports with active and passive participation of participants, while within the sport with active participation, sport Institutionalized/organized and non-institutionalized/unorganized.

Non-institutionalized sports consist of unorganized groups or individuals who practice sports independently and finance these activities from their resources (so-called household expenses). For example, an individual individually decides to improve their condition in a fitness center, or a group of work colleagues participates in "teambuilding" in which they go on a hiking trip, etc. Direct financing of sports from public funds mainly affects institutionalized, i.e. organized sports (sports clubs, professional sports in general...), which is also confirmed by

Sam and Jackson (2018). However, this should not only depend on public resources but also diversify income. The passive components of sports are individuals/groups, where we mainly include sports fans.

As part of the social impact of sport, it is important not to forget the existence of externalities of sports activities. Medveď, Nemec, and the collective of authors (2011) refer to externalities as situations where economic activity brings someone a benefit - a positive externality and someone a loss - a negative externality, without having to pay for such a benefit or to compensate him for any damage. Downward, Dawson and Dejonghe (2009) agree that externalities form one of the basic starting points for the creation of public policies for the field of sports.

According to the European Commission's Physical Activity Guidelines - Recommended Policy Actions in Support of Health-Enhancing Physical Activity (2008), regular physical activity significantly reduces the risk of developing cardiovascular diseases, selected types of cancer, reduces the stress factor and many others (European Commission, 2008). Sport is also an activity for building social contact. According to an article published in The New York Times (Reynolds 2016), 30 minutes of activity 5 times a week means a savings of $2,500 in annual healthcare expenses, while the population's sports inactivity has a global impact of $68 billion per year in healthcare and lost productivity.

Public funds participate directly in the financing of sports opportunities within the framework of unorganized sports, especially in the form of investments in sports infrastructure (multifunctional playgrounds, cycle paths, etc.) and indirectly, in the form of popularization within the framework of programs to support physical activities of the population - at the European level, such an activity is #BeActive within which The European Week of Sport is also implemented. European initiatives implemented within individual policies and their financing were comprehensively dealt with by Schwarcz et al. (2011). At the same time, however, Fiľa and Juráňová (2015) point out that many strategic documents of public policies often have only a declaratory nature, and the set goals and their fulfillment are not further monitored and regularly evaluated.

3 FINANCING OF SPORT AND ITS IMPACT ON SELECTED MACROECONOMIC INDICATORS

At the "EU Conference on Sports Statistics", held in March 2011, the need to create a system of uniform statistical evidence of sports in the European Union was identified, mainly due to the subsequent creation of public policies in the field of sports. Andreff and Szymanski (2006) characterize satellite accounts as a set of national statistical reporting techniques that cover a specific area, stating that some of the first satellite accounts in the field of sport originated in France and Germany. Sports satellite accounts therefore represent a certain standardized approach in the compilation and subsequent evaluation of selected indicators, allowing to measure the impact of sports on the economy, particularly the share of sports in the creation of gross domestic product, the share of employment, and total expenses. Shoji et al. (2018) perceive satellite accounts as a defined summary set of goods and services from the field of sports, which, however, must take into account the specifics of national economies.

In 2018, the European Commission's study "Study on the economic impact of sport through sport satellite accounts" was published, which summarized the impact of sport on the economies of individual countries and the countries of the Union and the European Union itself, precisely through the methodology of satellite accounts. The data analyzed comes from 2012 and is summarized in the following table. In addition, Ahlert (2013) states that household expenses contribute most significantly to the value of the GDP indicator from sports.

Table 1: Public funds invested in sports in % of GDP in the EU

EU28	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Belgium	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Bulgaria	0,4	0,2	0,2	0,2	0,1	0,2	0,2
Czechia	0,4	0,4	0,4	0,5	0,5	0,5	0,4
Denmark	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Germany	0,3	0,2	0,2	0,3	0,3	0,3	0,3
Estonia	0,4	0,4	0,6	0,5	0,6	0,6	0,6
Ireland	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Greece	0,4	0,4	0,4	0,4	0,4	0,5	0,5
Spain	0,4	0,4	0,4	0,4	0,4	0,4	0,4
France	0,5	0,5	0,5	0,5	0,6	0,6	0,5
Croatia	0,5	0,4	0,3	0,3	0,3	0,4	0,4
Italy	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Cyprus	0,3	0,3	0,3	0,3	0,4	0,3	0,2
Lithuania	0,3	0,3	0,3	0,3	0,2	0,2	0,2
Latvia	0,1	0,2	0,2	0,2	0,3	0,3	0,3
Luxembourg	0,4	0,5	0,5	0,5	0,5	0,5	0,5
Hungary	0,5	1,1	1,2	1,0	1,1	1,3	0,9
Malta	0,1	0,1	0,2	0,2	0,2	0,2	0,2
The Netherlands	0,6	0,5	0,5	0,5	0,5	0,6	0,5
Austria	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Poland	0,4	0,3	0,4	0,5	0,4	0,4	0,4
Portugal	0,3	0,3	0,3	0,3	0,3	0,3	0,4
Romania	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Slovenia	0,3	0,3	0,3	0,3	0,3	0,3	0,3
Slovakia	0,2	0,2	0,1	0,2	0,2	0,2	0,2
Finland	0,5	0,5	0,5	0,6	0,6	0,6	0,5
Sweden	0,5	0,5	0,5	0,5	0,6	0,6	0,6

(Source: Eurostat n.d.)

The allocation and reallocation of public resources within the sports financing systems within the EU countries is decided by the interest in prioritizing a specific area of sports. In their study, De Bosscher, Shibli, and Weber (2019) found that smaller countries (such as Slovakia) prefer financing elite sports more than, for example, mass sports and tend to be less successful than those that favor less. The table below shows the total public expenditure invested in sports as a % share of GDP.

Table 2: Allocation of public funds to sport in 2021 within EU countries

State	Central government in mil. EUR	% of total expenditures	Local self-government in million EUR	% of total expenditures
Belgium	-	-	-	-
Bulgaria	158.7	66.76	79	33.24
Czechia	342	33.88	667.4	66.12
Denmark	163.1	13.16	1076.2	86.84
Germany	-	-	-	-
Estonia	61.1	28.52	153.1	71.48
Ireland	247.4	68.06	116.1	31.94
Greece	71	7.40	889	92.60
Spain	218	4.57	4551	95.43
France	1207	8.83	12462	91.17
Croatia	39.9	18.76	172.8	81.24
Italy	4063.9	74.57	1386	25.43
Cyprus	42.4	82.17	9.2	17.83
Latvia	21.7	28.74	53.8	71.26
Lithuania	37.9	22.24	132.5	77.76
Luxembourg	54.7	15.41	300.2	84.59
Hungary	1047	74.94	350.2	25.06
Malta	-	-	-	-
The Netherlands	615	12.38	4354	87.62
Austria	-	-	-	-
Poland	314.5	13.49	2017.4	86.51
Portugal	54.7	6.99	727.7	93.01
Romania	198.4	30.27	457.1	69.73
Slovenia	23	15.88	121.8	84.12
Slovakia	163.2	56.43	126	43.57
Finland	211	15.22	1175	84.78
Sweden	742.8	21.00	2794.1	79.00

(Source: processed according to statistical data available on the site https://ec.europa.eu/eurostat/databrowser/view/GOV_10A_EXP$DV_584/default/table (2024))

An alternative to the insufficient resources for sports may appear to be a sharing system. As stated by Viglský and Fiľa (2023), the sharing of resources itself is not only interesting from the point of view of minimizing ownership costs but has much greater importance from the point of view of the environment.

4 SPORTS ACTIVITY OF THE POPULATION OF EUROPEAN UNION COUNTRIES

The literature considers the already mentioned positive externalities of sport to be the most significant social contribution of sports activity. Based on the main strategic document of the European Commission "White Paper on Sport", which was developed in 2007, we can define the following general goals of public policy in the field of sport:

1. Support of a healthy way of life of the population
2. Support for the development of sports for all/amateur sports (so-called "grassroots sports")

3. Support of social inclusion and development of volunteering
4. Prevention of negative phenomena in sports (match-fixing, doping, etc.)
5. Support of professional sports and sports representation of countries.

In the table below, we have prepared an overview of the sports activity of the population of all member countries of the European Union for the year 2022. Among the countries with the most active population in sports, the Nordic countries (Denmark, Finland, Sweden) are among the countries with the highest involvement of the population in sports activities. Among the countries with the lowest involvement of the population in sports activities, we include, for example, Bulgaria, Greece, and Portugal.

Table 3: Sports activity indicators within individual EU countries

	reGULARLY	With some regularity	OccaSIONALLY	AT ALL
EU28	6%	32%	17%	45%
BE	4%	39%	29%	28%
BG	4%	17%	18%	61%
CZ	7%	37%	30%	26%
DK	11%	48%	21%	20%
D-W	8%	38%	25%	29%
DE	8%	35%	25%	32%
D-E	8%	26%	21%	45%
EE	8%	34%	28%	30%
IE	13%	41%	11%	35%
EL	4%	19%	9%	68%
ES	11%	31%	11%	47%
FR	8%	33%	14%	45%
HR	6%	24%	30%	40%
IT	3%	31%	10%	56%
CY	11%	29%	14%	46%
LV	9%	30%	28%	33%
LT	9%	23%	15%	53%
LU	13%	50%	16%	21%
HU	4%	22%	15%	59%
MT	7%	25%	37%	31%
NL	7%	53%	15%	25%
AT	7%	35%	23%	35%
PL	2%	21%	12%	65%
PT	4%	18%	5%	73%
RO	2%	18%	18%	62%
SI	11%	41%	23%	25%
SK	6%	29%	22%	43%
FI	18%	53%	21%	8%
SE	9%	50%	29%	12%

(Source: processed according to statistical databases Eurobarometer 525 Sport and physical activity[1] (2024))

1 Available at: https://data.europa.eu/data/datasets/s2668_97_3_sp525_eng?locale=en

5 METHODOLOGY

In connection with the main goal and thus with the identification of the success of the sports' public policies regarding the sporting activity of the population, we formulated the research question:

1. Evaluating the effectiveness of current sports policies in promoting a healthy lifestyle in the EU countries.

A partial objective is related to the above research question:

1. Identify whether the volume of public funds invested in sports has an impact on the sports activity of the population.

The object of investigation is the systems of sports funding in the countries of the European Union. The source of information is secondary data contained in strategic documents governing the field of sport in selected EU countries, data contained in Eurobarometer 525 and the study corresponding to the time "Study on the economic impact of sport through sport satellite accounts" and its EUROSTAT datasets focused on the field of sport. Data covering the physical activity is limited only to Eurobarometers which collects the statistical data from all European countries, and therefore the methodology used to collect them is the same.

Empirical exploratory, comparative, and statistical methods of secondary data research are used to fulfill the main goal. The basis of the analytical tools used in identifying the impact of the volume of public investments in sports and sports activity is a linear regression analysis. In our case, linear regression analysis examines the possible relationship between two variables, where we assume that the value of the dependent variable (Y – sports activity) is affected by the change in the value of the independent variable (X – volume of invested public funds). The formula of the linear regression analysis for the purposes of the analytical part is as follows (b0 is the point where the regression line crosses the Y axis, b1 is the regression coefficient that determines the direction of the line, e is the measurement error):

$Y = b0 + b1 * X + e$

6 ANALYTICAL OUTPUT AND DISCUSSION

To identify the success of individual sports funding systems within the EU countries, we will focus on the relationship between the allocation of public funds and the sports activity of the population. In the following table, we have countries ranked from the most active in sports to the least active in sports, with the identification of the allocation of public funds at individual levels of government.

Whether the population of a given country is more active in sports is not related to the allocation of public funds for sports within the individual levels of the state establishment and thus to the organizational division of sports management.

For the analysis of the relationship between the dependent variable (sports inactivity) and the independent variable (the volume of public funds invested in sports in % of GDP), we will choose a linear regression in the following table and similarly, in others, we have the output of the regression analysis shown, the inputs of which were the data of the EU member states in years of measurement of sports activity by individual Eurobarometers.

Table 4: Output of linear regression analysis

Regression Statistics	
Multiple R	0,33596
R Square	0,112869
Adjusted R Square	0,10205
Standard Error	0,1523
Observations	84

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0,241991	0,241991	10,432789	0,00178212
Residual	82	1,902012	0,023195		
Total	83	2,144004			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0,519757	0,038922	13,35365	2,845E-22	0,44232771	0,59718603
Public funds % GDP	-0,31726	0,098224	-3,22998	0,0017821	-0,5126604	-0,121863

(Source: Authors'.)

From the output of the regression analysis, only 11% of the variation in the set y (sports inactivity) can be explained by changes in the independent variable x. The results of the analysis can be considered statistically significant. The above indicates that the change in the volume of public funds invested in sports does not have a significant impact on the indicator of sports inactivity.

From the research carried out by the authors so far, it follows that even the changes in the value of sports activity of the population cannot be sufficiently explained:

a) nor by changes in the value of the volume of public investments in sports, expressed as a % share of GDP. Škoric and Hodak (2011) also state that the sports development indicator expressed by the number of registered athletes does not depend on the volume of invested public funds,
b) nor by changes in the value of the purchasing power parity of the population (purchasing power parity – real expenditures in GDP per 1 inhabitant),
c) nor by changes in the value of total employment of the population,
d) nor by a combination of the above-mentioned 3 macroeconomic indicators.

In his study, Andreff (2009) devoted himself to the GDP indicator, which, according to his results, has the most significant influence on the indicator of the number of active sportsmen. The value of GDP per 1 inhabitant, together with the value of employment, are one of the main macroeconomic indicators of the economic maturity of countries, and therefore more available financial resources of the population logically presuppose higher expenditures on goods/services that do not cover only basic life needs. Within the European Union, we include the Nordic countries among the countries with the highest standard of living, within which the values of sports activity are also one of the highest. However, it is not possible to apply this rule universally, as Portugal or Spain, for example, have a higher standard of living than the Slovak Republic, but the value of the population's sports activity is lower. Kondrla et al. (2023) state that the immediate and even causal link between knowledge and action is also a problem.

In their study, Škoric and Hodák (2011) focused on the dependence of the number of registered athletes within sports organizations on the volume of invested public funds. Škoric, Bartoluci, and Čustonja (2012) examined the dependence of sports medal achievements on the volume of invested public funds. In their research, Ivaškovič and Čater (2018) focused on the impact of public funds on the activities of selected sports organizations and the effectiveness of fulfilling their own goals when using public funds.

7 CONCLUSIONS

The support of a healthy way of life for the population and thus sports activity is one of the most important points of the strategic document "White Paper on Sport". The main goal of the analytical part of the article was to evaluate the effectiveness of the sports funding systems in the European Union countries and identify a possible relationship between the amount of public funds invested and the sporting activity of the population.

As part of the analytical part of the work, this assumption was disproved that the allocation of public funds does not affect the level of sports activity of the population. The sports activity itself, or the inactivity of the population, cannot be linked to the volume of public funds invested in sports expressed as a % share of GDP.

Possible reasons for the statistically insignificant impact of the volume of public funds invested in sports on the level of sports activity of the population may lie in:

1. the absence of further justification as to why the population of a given country is more or less active in sports within the framework of surveys of the population's sports activity/inactivity,
2. preferences of professional sports over sports for all on the part of the state administration,
3. the absence of a regular audit of the success of public policy programs focused on the field of sport within individual EU countries.

On the basis of the performed regression analysis and the available empirical secondary data, it was demonstrated that the sports public policies in the European Union countries are not very successful in fulfilling their main goal – supporting the populations' healthy lifestyle and therefore it is necessary to focus more on the efficiency of the use of invested financial resources and the efficiency of implemented public policies in the field of sports. A very important element is the regular audit of sports policies and the setting of real measurable indicators/benchmarks. There is a clear absence of a regular audit of the success of public policy programs focused on the field of sport within individual EU countries.

The limitations lie mainly in the absence of a sufficient amount of literature covering the issue of effective/efficient use of public funds in the field of sports, especially in the field of sports' physical activity, which would allow to verify the results in wider perspective. It is also important to mention that policymakers in the strategic documents in the field of sport are not establishing benchmarks which would allow for assessing the effectiveness and efficiency on a regular basis (and therefore the application of recommendations into practice is very limited).

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

DANCE AS A FORM OF HOLISTIC THERAPEUTIC INTERVENTION FOR PEOPLE WITH PARKINSON'S DISEASE

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ABSTRACT

Parkinson's disease (PD) is a neurodegenerative disorder characterized by progressive motor and cognitive impairments that significantly impact daily functioning. While pharmacological treatments remain essential, their effectiveness declines over time, highlighting the need for complementary therapies.

Dance has emerged as a promising non-pharmacological intervention for PD, integrating motor, cognitive, emotional, and social benefits. It enhances balance, coordination, and mobility while stimulating cognitive function through choreographic memorization. Regular practice fosters neuroplasticity, strengthens neural pathways, and improves motor learning. Additionally, dance promotes emotional well-being by increasing dopamine and serotonin levels, reducing depression, and enhancing self-confidence. The social aspects of dance mitigate isolation and foster community engagement.

This paper explores the benefits of dance as a complementary therapy for PD, emphasizing its role in symptom management and quality of life enhancement. Given its holistic advantages, dance should be further integrated into PD treatment frameworks as an evidence-based therapeutic option.

***Keywords**: Parkinson's Disease, Think like a dancer, Dance intervention, Quality of Life, Dance-related benefits*

1 INTRODUCTION

Parkinson's disease (PD) is the second most prevalent neurodegenerative disorder, with the incidence and prevalence on the rise. It is estimated to affect approximately 3% of individuals aged 65 and older and up to 10% of those over 80 years (Campenhausen et al. 2005; Marras et al. 2018). The condition is primarily linked to the degeneration of dopamine-producing neurons originating in the brain structure called the substantia nigra pars compacta. Progressive loss of dopamine neurons results in the manifestation of motor symptoms such as resting tremors, rigidity, bradykinesia, and postural instability (Esposito, Di Matteo, and Di Giovanni 2007; Müller et al. 2019). By the time motor symptoms are evident, approximately 60% of nigral dopaminergic neurons have already been lost (Roytman et al. 2025), underscoring the late diagnosis of PD based on motor symptomatology.

Beyond motor symptoms, PD also involves significant cognitive impairments, which are often overlooked in the early stages of the disease. Cognitive decline, including deficits in attention, executive function, language, and visuospatial abilities, affects approximately one-third of patients already in the early stages of PD (Wu, Hallett, and Chan 2015; Kandiah et al. 2009; Peskar et al. 2025). Research suggests that motor and cognitive functions rely on overlapping neural networks (McIsaac et al. 2018; Cortney Bradford et al. 2019; Gramann et al. 2010; Gwin et al. 2011; Makeig et al. 2004; Polich 2007), which implies that the motor and cognitive functions share the same attentional resource pool. This overlap makes it challenging for individuals to process motor and cognitive tasks simultaneously, a difficulty exacerbated in people with PD (Heinrichs-Graham et al. 2014). When dual-task attentional demands exceed available cognitive resources, performance deterioration occurs, a phenomenon termed cognitive-motor interference (Marusic, Verghese, and Mahoney 2018). People with PD often compensate for impaired balance control by employing additional attentional strategies (Plummer et al. 2013). However, as the disease progresses and the cognitive system itself becomes compromised, these compensatory mechanisms become less effective. While PD is primarily characterized by motor symptoms, its non-motor manifestations, including cognitive impairments, require greater attention in early diagnosis and comprehensive management.

Additionally, this multifaceted and complex disease often poses social and psychological challenges to people suffering from it. Individuals with Parkinson's disease often experience difficulties producing emotional facial expressions (facial masking) and emotional speech (dysarthria), along with challenges in recognizing the emotional cues of others (Prenger et al. 2020). In addition, the tremors can become a source of social embarrassment and result in avoiding actions where the tremor might become exposed, such as pointing to objects or shaking hands with other people (Houston 2019). Such social symptoms can result in significant negative outcomes, including stigma, dehumanization, and people with PD might avoid leading social interactions and become more isolated or lonely. Furthermore, psychological challenges, such as depression and low self-esteem, may be a consequence of gradual physical symptoms, demonstrating the interrelated and complex nature of the disease (Houston 2019).

Given the persistent motor and non-motor challenges in Parkinson's disease—including balance impairments, speech and communication difficulties, social withdrawal, and diminished quality of life - this narrative review aims to synthesize current evidence on how dance interventions exert beneficial effects across all these domains of functioning, highlighting their unique position among complementary therapies for PD. This paper presents the idea of »*The four pillars of improved quality of life*«, all targeted by a single intervention – dancing.

2 PARKINSON'S DISEASE AND THE ROLE OF DANCE IN THERAPEUTIC INTERVENTIONS

Parkinson's disease (PD) is an incurable neurodegenerative disorder. Pharmacological treatments are indispensable for improving the overall functioning of people with PD, however, they are often insufficient. Also, the effectiveness of the medication diminishes over time and its positive effects on mood and motor control wear off after approximately five years of continuous ad-

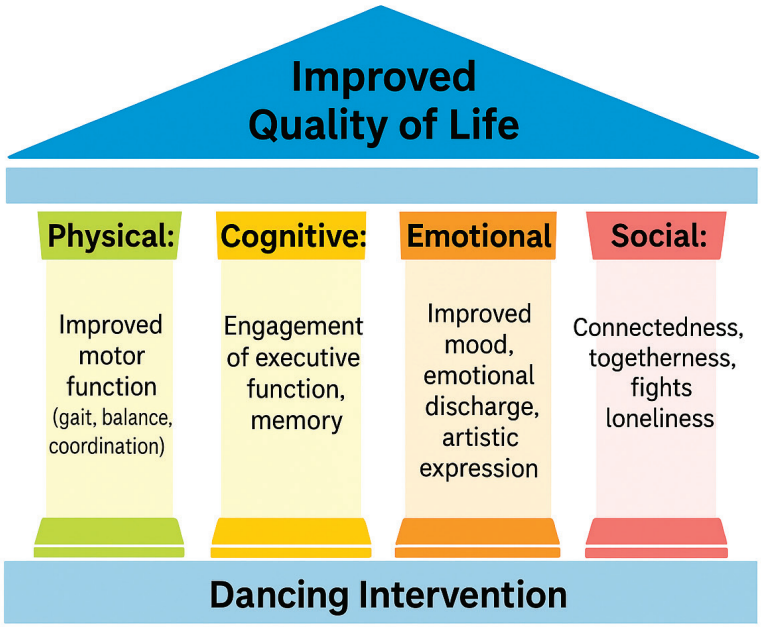
ministration (Mizuno, Shimoda, and Origasa 2018). The challenges that people with PD face span across several fields of human functioning, which makes symptom management quite difficult and/or time-consuming. Over time, some symptoms become more pronounced and new ones arise, highlighting the ever-changing nature and the progressive character of the disease (Houston 2019). This poses complementary therapies as a critical component in the care of people with PD (McGill, Houston, and Lee 2014). Therapies beyond the medication schedule that manage symptoms and improve quality of life are crucial healthcare interventions for both patients and their caregivers.

Among the available therapeutic approaches, dance occupies a unique position due to its simultaneous engagement of motor, cognitive, emotional, and social functions. Through structured movement, sequence memorization, and group interaction, dance provides a holistic intervention that aligns with the complex needs of individuals with PD (McGill, Houston, and Lee 2014). Below, we explore the specific benefits of dance as a therapeutic tool, examining its physical, cognitive, emotional, and social advantages.

3 THE BENEFITS OF DANCE FOR INDIVIDUALS WITH PARKINSON'S DISEASE

Physical activity is widely recognized for its role in slowing PD progression, yet individuals with PD engage in physical exercise 29% less frequently than older adults without the condition (Nimwegen et al. 2011). This highlights the necessity of promoting engaging and enjoyable forms of movement. Dance has emerged as an effective intervention that integrates multiple dimensions of well-being and promotes the quality of life (see Figure 1).

Figure 1: The four pillars of dancing intervention-related advantages leading to improved quality of life: physical, cognitive, emotional, and social.



3.1 Physical Benefits

Dance addresses key motor impairments in PD by improving gait, balance, coordination, and overall mobility. Research suggests that effective exercise programs for PD should incorporate elements that enhance muscle strength, flexibility, and postural stability to facilitate daily activities (Keus et al. 2007; Bouça-Machado et al. 2020). Dance naturally fulfils these criteria while also incorporating rhythmic movement, which can enhance motor control and endurance. It em-

phasizes joint activation, moderate stretching, and mindful movement, which have been advocated for PD management. Dance integrates these various principles, making it a highly effective therapeutic modality (McNeely, Duncan, and Earhart 2015).

The presence of music further amplifies dance's motor benefits. Auditory cues serve as external stimuli that aid movement initiation and coordination, particularly beneficial for individuals experiencing freezing of gait and bradykinesia (Earhart 2009). Additionally, the multitasking demands of dance, such as executing choreographed sequences to enhance motor learning, strengthen neural connections and facilitate the automation of movements when practiced regularly (Earhart 2009).

3.2 Cognitive and Emotional Benefits

Dance requires individuals to memorize and execute movement sequences, engaging cognitive processes such as attention, planning, and problem-solving. These activities stimulate neural plasticity, reinforcing existing neural pathways and creating new ones, which are critical for maintaining cognitive function in PD (Meulenberg et al. 2023). Regular participation in dance classes has been associated with improved executive function and working memory, contributing to greater independence in daily life (Kalyani et al. 2019).

Beyond cognitive stimulation, dance positively impacts emotional well-being. PD is often associated with mood disturbances, including depression and anxiety, due in part to the depletion of neurotransmitters such as dopamine and serotonin. Dance promotes emotional resilience by triggering the release of these neurochemicals, fostering joy, and enhancing self-confidence. Open, expansive movements encourage a sense of mastery and bodily control, contributing to greater self-esteem and emotional stability (Kalyani et al. 2019; McGill, Houston, and Lee 2014).

3.3 Social Benefits

The social aspect of dance is particularly valuable for individuals with PD, who may experience isolation due to mobility limitations and communication difficulties. Dance classes provide a structured yet supportive environment that fosters connection and social engagement. Sessions often include caregivers and family members, strengthening interpersonal relationships and offering opportunities for shared experiences. By encouraging interaction in a non-medicalized setting, dance helps cultivate a sense of community and belonging, which is essential for psychological well-being (Houston 2019; McGill, Houston, and Lee 2014).

4 DANCE FOR PD: A STRUCTURED APPROACH

The "Dance for PD" program, developed by the Brooklyn Parkinson Group in collaboration with the Mark Morris Dance Group under the leadership of David Leventhal, exemplifies the integration of dance into therapeutic practice. This method shifts the participant's role from "patient" to "student," framing dance as an artistic and creative endeavour rather than merely a rehabilitative exercise (Move4Parkinsons 2014).

David Leventhal (Move4Parkinsons, 2014) describes the program's philosophy as transitioning from the "black-and-white world of disease" to the "colourful world of art." Classes take place in a dance studio, reinforcing an identity centered on movement and expression rather than illness. The program incorporates key motor principles, including balance, coordination, flexibility, and endurance, which are essential for maintaining daily functioning. Additionally, choreographed sequences activate widespread neuronal networks, fostering cognitive engagement and enhancing motor learning (Meulenberg et al. 2023).

In addition to physical and cognitive advantages, Dance for PD emphasizes emotional and social enrichment. Expressive movements and musical accompaniment evoke positive emotions, while group participation strengthens social bonds. Encouraging family members and caregivers to join classes further enhances relational dynamics and support systems, creating a holistic therapeutic environment (Move4Parkinsons, 2014).

5 SYNTHESIS

By addressing physical, cognitive, emotional, and social needs, dance offers a comprehensive and engaging intervention for individuals with Parkinson's disease. Its ability to merge artistic expression with evidence-based therapeutic principles positions it as a powerful complementary approach in PD management. While research highlights the benefits of various dance practices in managing physical (Sharp and Hewitt 2014; Moț and Almăjan-Guță 2022) and cognitive (Mitterová et al. 2021; Ulman et al. 2020; Meulenberg et al. 2023; Gil et al. 2024; De Natale et al. 2017) symptoms, as well as emotional- and mental well-being while fostering social connection (Jola, Sundström, and McLeod 2022; Cheng, Quan, and Thompson 2024; Colombo et al. 2022)quantitative evidence of the benefits is inconsistent and often lacks in power. For a better understanding of the contradictory findings between participants' felt experiences and existing quantitative findings in response to dance classes, we employed a mixed method approach that focussed on the effects of music. Participant experience of the dance class was explored by means of semi-structured interviews and gait changes were measured in a within-subjects design through the Timed Up and Go (TUG, the field lacks randomized controlled trials rigorously comparing across different types of dancing, intervention durations, frequency of session, and the effects they have in different PD stages and phenotypes. Following such systematic comparisons, clearer guidelines on the integration of dancing programs such as Dance for PD into clinical practice may be offered. As long as no cure remains available for PD, the affected individuals will seek useful complementary therapies as a means to regain some control over their health, while the priority of the health care system should be to offer guidance with clear direction.

6 CONCLUSION

Quality of life is a multidimensional construct encompassing physical, psychological, social, and environmental domains, each contributing uniquely to an individual's overall well-being. Quality of life reflects an individual's perception of their position in life within their cultural context and value system, in relation to their goals, expectations, standards, and concerns (Pinto et al. 2017). This comprehensive framework underscores that well-being extends beyond the absence of disease or the absence of symptoms, highlighting the importance of emotional balance, social connections, and environmental factors in achieving a fulfilling life (Jones and Drummond 2021; Wong et al. 2018). Acknowledging the interplay of these domains is crucial for developing holistic interventions that enhance quality of life across diverse populations, including and especially people with chronic diseases, such as Parkinson's disease.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

BIOCHEMICAL PROFILES IN PATIENTS WITH CHRONIC RESPIRATORY DISORDERS DURING COVID-19 AND THE POST-COVID PERIOD

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ABSTRACT

Introduction: The COVID-19 pandemic has presented significant challenges for individuals with chronic respiratory diseases, affecting their biochemical profiles and clinical outcomes. Understanding these changes is essential for optimizing patient management. This study aimed to assess biochemical changes in patients with chronic respiratory diseases during and after COVID-19, focusing on inflammatory, metabolic, and renal markers.

Methodology: A retrospective clinical study and systematic literature review were conducted. Biochemical parameters including CRP, D-Dimer, AST, ferritin, ALT, glycemia, urea, and creatinine were analyzed. Statistical analysis was performed to compare levels during and after COVID-19. Study sample: 75 patients diagnosed with COPD, bronchial asthma, or chronic bronchitis and also COVID-19 were included. Data were collected from private laboratories in Tirana during 2021-2022 period.

Results: Significant increases were observed in CRP, D-Dimer, AST, and cholesterol during COVID-19, with no significant changes in ferritin, ALT, glycemia, urea, or creatinine levels after Covid-19.

Conclusions: This population study differs from general populations, showing distinct biochemical changes likely due to chronic respiratory pathologies. Recommendations include regular biomarker monitoring, personalized metabolic control, and integrated care approaches.

Keywords: *Biochemical analyses, Covid-19, Pandemic, Post covid, Chronic respiratory disorders*

1 INTRODUCTION

Viral infectious diseases represent a major challenge for human health. After the emergence of a new pneumonia from coronavirus, more than 10,000 types of previously unknown viruses have been mentioned by the mass media, but only a few are well known. In recent decades, human beings have continuously faced the challenge of bacterial and viral infections. The most common pathogens of new infectious diseases are viruses, most recently Covid (Chen et al. 2023).

There are many common viruses that can cause respiratory infections, including influenza-related viruses, human metapneumovirus, measles virus, rhinovirus, enterovirus, coronavirus, respiratory syncytial virus, adenovirus, cytomegalovirus, herpes simplex virus, etc. There are more than 100 types of coronaviruses and their study is of particular interest to medical specialists (Saxena et al. 2019; Zhu et al. 2023).

In Albania, the epidemiology of COVID-19 reveals some obvious trends. The data show a slightly higher rate of infection in women. The age group most affected by infections is between 30 and 59 years old, with this demographic showing the highest incidence of cases. However, the highest mortality rates are observed in men, especially those aged 70 years and older, highlighting a gender and age disparity in severe outcomes (Petri et al. 2022; Gaxhja et al. 2024).

The prevalence of SARS-CoV-2 infection was found to be 31.1%, with a mean age of 42.17 ± 18.6 years among those infected. The most affected age groups were 31-40 years old and 41-50 years old, with infection rates of 17.3% and 16.3%, respectively. Many patients reported experiencing multiple symptoms concurrently during their illness, with more than half reporting at least two symptoms concurrently and approximately one-third reporting three or more symptoms. Analysing symptom onset with total symptoms and comorbidities, some patients were affected for many days with few symptoms and few comorbidities. It seems they started as mild cases for many days unpredictably precipitating (Petri et al. 2022; Çomo et al. 2023).

In patients who have passed the Covid-19 infection, it has been noticed that this virus has affected many organs and systems besides the respiratory one, leading, among other things, disorders of renal, hepatic, coagulation function and beyond. Not only during the acute phase of the infection, but biochemical panel disorders have also been observed in post-Covid patients, leading various acute, chronic complications or even predicting the mortality of this infection (Petri et al., 2022). Therefore, through this paper, we analysed the abnormalities of the biochemical panel during Covid-19 and post-Covid 19 in patients with respiratory disorders to give a clearer framework of the changes encountered, especially in Albanian patients.

1.1 Overview of Covid-19

SARS-CoV-2 is a new type of coronavirus that was not previously identified in humans. It has been declared a pandemic by the WHO, because it had infected 704,753,890 individuals and caused 7,010,681 deaths by April 2024 (Rauf et al. 2020).

Phylogenetic examination suggests that SARS-CoV-2 may have originated from the zoonotic cycle and spread rapidly from human to human. However, the exact origin of SARS-CoV-2 cannot yet be specified with certainty. Transmission between humans occurs through close contact with an infected individual who produces droplets when coughing or sneezing within a distance of about 2 meters (Rauf et al. 2020).

The incubation period from exposure to the appearance of symptoms is generally 7-14 days; the shortest is 1 day, the longest is up to 20 days. Fever, fatigue and dry cough are the most common symptoms at the onset of the disease, but they also appear in flu and other respiratory infections and are non-specific. Upper respiratory tract symptoms such as nasal congestion and rhinorrhoea are relatively rare. Severe cases of infection cause pneumonia, severe acute respiratory syndrome, renal failure and death. Fatal cases are usually seen in the elderly and those with chronic diseases such as diabetes and heart disease (Rauf et al. 2020).

1.2 The physiopathology of Covid-19

Asymptomatic stage: SARS-CoV-2 is acquired via respiratory aerosols and binds to nasal epithelial cells in the upper respiratory tract. The main host receptor for viral entry into cells is ACE-2, which is seen to be highly expressed in nasal epithelial cells. The virus undergoes local replication and spread, infecting ciliated cells in the conducting airways. This phase lasts several days and the immune response generated during this phase is limited (Zhu et al. 2023).

Invasion and infection of the upper respiratory tract: At this stage, the virus migrates from the nasal epithelium to the upper respiratory tract through the conducting airways. Due to the involvement of the upper respiratory tract, the disease manifests itself with symptoms of fever, body weakness and dry cough. There is a greater immune response during this phase that involves the release of C-X-C motif chemokine ligand 10 (CXCL-10) and interferons (IFN-β and IFN-λ) from virus-infected cells. Most patients do not progress beyond this stage as the accumulated immune response is sufficient to inhibit the spread of infection (Zhu et al. 2023).

Lower respiratory involvement and progression to acute respiratory distress syndrome (ARDS): About one-fifth of all infected patients progress to this stage of the disease and develop severe symptoms. The virus enters type 2 alveolar epithelial cells via the ACE-2 receptor and begins to undergo replication to produce more viral nucleocapsids.

Virus-laden pneumocytes now release many different cytokines and inflammatory markers such as interleukins (IL-1, IL-6, IL-8, IL-120 and IL-12), tumor necrosis factor-α (TNF-α), IFN-λ and IFN--β, CXCL10, monocyte chemotactile protein-1 (MCP-1), and macrophage inflammatory protein--1α (MIP-1α) (Ball et al. 2022). This 'cytokine storm' acts as a chemotactile factor for neutrophils, CD4+ helper T lymphocytes, and CD8+ cytotoxic T lymphocytes, which then begin to sequester in the lung tissue. These cells are responsible for fighting the virus but are also responsible for the subsequent inflammation and pulmonary damage. The host cell undergoes apoptosis releasing new viral particles, which then infect neighbouring type 2 pneumocytes in the same manner. Due to ongoing damage caused by sequestered inflammatory cells and viral replication leading to the loss of type 1 and type 2 pneumocytes, diffuse alveolar injury develops that eventually culminates in an acute respiratory distress syndrome (Ball et al. 2022).

2 PURPOSE AND GOALS

This study aimed to assess biochemical changes in patients with chronic respiratory diseases during and after COVID-19, focusing on inflammatory, metabolic, and renal markers. The general objective was to assess the impact of COVID-19 infection on biochemical parameters in patients with chronic respiratory disease, focusing on variations during the acute phase of Covid-19 and the post-recovery period.

Overall objective

To assess the impact of COVID-19 infection on biochemical parameters in patients with chronic respiratory diseases, focusing on variations during the acute phase of Covid-19 and the post-recovery period.

Specific objectives

- To analyze changes in biochemical parameters during the acute phase of COVID-19 infection among patients diagnosed with chronic respiratory diseases (COPD, bronchial asthma, chronic bronchitis), focusing on markers such as inflammatory cytokines, hepatic enzymes and renal function tests.
- To assess the trajectory of recovery of biochemical parameters after COVID-19 infection in patients with chronic respiratory diseases, assessing how parameters such as inflammatory markers, renal and hepatic function tests and lipid profiles normalize or remain altered over time.
- Comparison of biochemical profiles between chronic respiratory disease pathologies (COPD, bronchial asthma, chronic bronchitis) in patients with COVID-19, aiming to identify specific patterns or markers that may be associated with disease severity and clinical outcomes.

3 METHODS

The study uses a retrospective clinical methodology to analyse biochemical parameters in 75 patients diagnosed with chronic respiratory diseases (COPD, bronchial asthma, chronic bronchitis) and Covid-19 during the years 2021-2022, using data from private laboratories in Tirana. Biochemical tests include blood glucose, liver function (ALT, AST), renal function (creatinine, BUN), inflammatory markers (CRP, D-Dimer), and lipid profiles. Statistical analysis includes descriptive statistics and paired tests to assess changes in biochemical parameters before and after Covid-19 infection.

At the same time, a systematic literature review covering 2014-2024 was conducted using PubMed, Scopus and Web of Science to synthesize existing evidence on biochemical changes in Covid-19 patients with chronic respiratory disease. The review includes studies reporting on inflammatory markers, hepatic enzymes and renal function during Covid-19. Data extraction and quality assessment were performed to summarize the findings, providing a comprehensive understanding of the biochemical responses to Covid-19 in this patient population.

SPSS 20.0 statistical software was used for data analysis. Continuous variables were summarized as mean ± standard deviation (SD) and other descriptive statistics, while categorical variables were presented as proportion of patients in each category expressed as percentage. Chi-square test and Fisher exact test were used to compare proportions between categorical variables. Point estimates were accompanied by 95%CI confidence interval. The nonparametric Man Whitney test was used to compare the values of visus cc and visus sc between the two eyes. A p value of ≤0.05 was considered statistically significant. All statistical tests are two-sided. Tables, diagrams and graphs were used to visualize the data.

4 RESULTS

First, gender and age were analysed in the patients examined. 60% of the patients (n=40) examined belong to the female gender. 40% of the patients involved in this study belong to the age group over 70 years, followed by 32% of the total which belong to the age group 61-70 years.

Figure 1: Distribution of patients according to gender

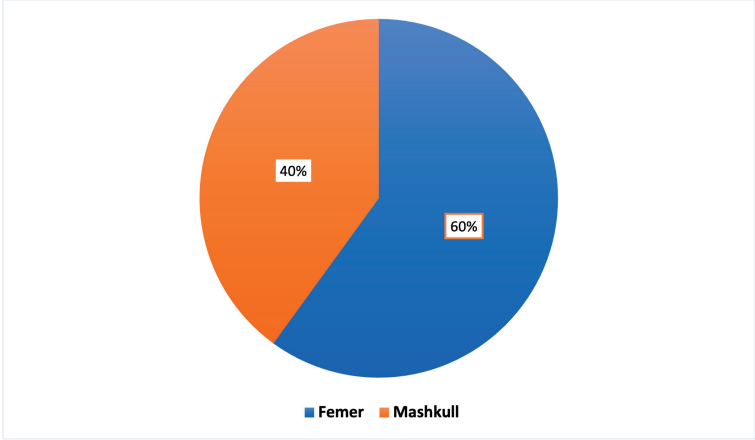

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Table 1: Comparison of CRP in clinical cases during acute Covid-19 infection and after recovery

Statistic (Paired Sample Test)	Value CRP during and post-COVID-19
Mean Difference	10.50412
Standard Deviation	32.80142
Standard Error Mean	7.95551
95% Confidence Interval	-6.36082 to 27.36905
t-value	1.320
Degrees of Freedom (df)	16
Sig. (2-tailed)	**0.205**

The above table shows the results of a **Paired Samples T-Test** comparing **CRP levels during Covid-19 („CRP gjate Covid-19")** and **CRP levels post Covid-19 („CRP post Covid-19")**. The Average level of CRP during COVID-19 was higher compared to the post-COVID-19 period.

The p value of 0.205 indicates that the difference in CRP levels between the two periods is not statistically significant ($p > 0.05$).

The 95% confidence interval of the difference includes zero (from -6.36 to 27.37), further confirming no significant difference.

Table 2: Comparison of D-DIMER in clinical cases during acute Covid-19 infection and after recovery

Statistic - Paired Samples T-Test	Value of D-DIMER levels during and post Covid-19.
Mean Difference	354.40909
Standard Deviation	815.68398
Standard Error Mean	173.90441
95% Confidence Interval	-7.24492 to 716.06311
t-value	2.038
Degrees of Freedom (df)	21
Sig. (2-tailed)	0.054

Table 2 presents the results of a **Paired Samples T-Test** comparing **D-DIMER levels during Covid-19** and **D-DIMER levels post Covid-19**.

The mean D-Dimer level during COVID-19 was higher compared to the post-COVID-19 period. The analysis shows that there is a borderline statistically significant difference ($p=0.054$) in D-Dimer levels during and after COVID-19 infection. The higher mean difference during the period of active infection suggests increased coagulation activity or thrombotic risk during COVID-19.

Table 3: Comparison of urea in clinical cases during the treatment of Covid-19 and after recovery

Statistic - Paired Samples T-Test	Value of UREA levels during and post Covid-19
Mean Difference	6.15
Standard Deviation	12.67912
Standard Error Mean	3.16978
95% Confidence Interval	-0.60622 to 12.90622
t-value	1.940
Degrees of Freedom (df)	15
Sig. (2-tailed)	0.071

This third table shows the results of a Paired Samples T-Test comparing UREA levels during Covid-19 and UREA levels post Covid-19. The mean urea level during COVID-19 was higher compa-

red to the post-COVID-19 period. The p-value of 0.071 indicates that the difference in urea levels between the two periods is not statistically significant ($p > 0.05$), although it is close to the significance threshold.

Table 4: Comparison of creatinine in clinical cases during acute Covid-19 infection and after recovery

Statistic	Value of Creatinine levels during and post-COVID-19
Mean Difference	2.68438
Standard Deviation	10.72713
Standard Error Mean	2.68178
95% Confidence Interval	-3.03171 to 8.40046
t-value	1.001
Degrees of Freedom (df)	15
Sig. (2-tailed)	**0.333**

Table 4 displays the results of a Paired Samples T-Test comparing Creatinine levels during Covid-19 and Creatinine levels post Covid-19.

The mean creatinine level during COVID-19 was higher compared to the post-COVID-19 period. The p value of 0.333 indicates that the difference in creatinine levels between the two periods is not significant ($p > 0.05$). There is no statistically significant difference in Creatinine levels during vs. after Covid-19 in this sample. The result does not suggest any meaningful trend, unlike the borderline cases of D-DIMER and URE

Table 5: Comparison of AST in clinical cases during acute Covid-19 infection and after recovery

Statistic	Value of AST levels during and post-COVID-19
Mean Difference	6.273
Standard Deviation	6.198
Standard Error Mean	1.869
95% Confidence Interval	2.109 to 10.437
t-value	3.356
Degrees of Freedom (df)	10
Sig. (2-tailed)	**0.007**

Table 5 shows a Paired Samples T-Test comparing AST levels during Covid-19 vs. AST levels post Covid-19. The mean difference in AST levels during and after COVID-19 indicates an increase during COVID-19. The p value of 0.007 indicates that there is a statistically significant difference in AST levels between the two periods ($p < 0.05$).

Table 6: Paired Samples T-Test Summary (Pre- vs. Post-COVID-19)

Test	Mean Difference	p-value	Statistically Significant?	Notes
CRP	10.50	0.205	No	Clearly non-significant
D-DIMER	354.41	0.054	No (borderline)	Near significance, possible trend
UREA	6.15	0.071	No (borderline)	Near significance, possible trend
Creatinine	2.68	0.333	No	Clearly non-significant
AST	6.27	0.007	**Yes**	Statistically significant difference

Table 6 presents the results of paired samples t-tests comparing various biochemical markers during and after COVID-19 infection. The goal was to assess whether there were statistically significant differences in laboratory values, which could reflect the physiological impact of the di-

sease over time. Only AST showed a statistically significant difference between during and post--COVID-19. D-DIMER and UREA showed borderline significance and may indicate a trend worth further investigation. CRP and Creatinine did not show significant changes.

Among the five tests analyzed (CRP, D-DIMER, UREA, Creatinine, and AST), only AST levels showed a statistically significant decrease post-COVID-19 ($p = 0.007$), suggesting a potential normalization of liver enzyme levels following recovery. This may reflect a resolution of liver stress or inflammation commonly observed during active viral infection.

Both D-DIMER ($p = 0.054$) and UREA ($p = 0.071$) demonstrated borderline significance, indicating possible trends toward improvement post-infection. However, these differences did not meet the conventional threshold for statistical significance ($p < 0.05$) and should be interpreted cautiously. With a larger sample size or reduced variability, these markers might yield significant results.

In contrast, CRP and Creatinine showed no statistically significant changes ($p = 0.205$ and $p = 0.333$, respectively). This suggests that systemic inflammation (CRP) and renal function (Creatinine) may not have significantly differed between the acute and recovery phases in this cohort.

Overall, these findings highlight the importance of monitoring specific biomarkers during and after COVID-19, as only certain parameters appear to significantly normalize post-infection. Further studies with larger sample sizes are recommended to validate these trends and explore their clinical implications.

5 DISCUSSION

From the data analysed, it resulted that:

The Average level of **CRP** during COVID-19 was higher compared to the post-COVID-19 period. The p value of 0.205 indicates that the difference in CRP levels between the two periods is not statistically significant ($p > 0.05$). Chronic obstructive pulmonary disease (COPD) is a condition associated with significant morbidity and mortality. The heterogeneous nature of this disease makes it difficult for clinicians to predict prognosis and response to treatment based exclusively on clinical or functional data. In the stable phase, biomarkers associated with interleukin (IL)-6-mediated inflammation, such as C-reactive protein (CRP) and fibrinogen, are known to be associated with an increased risk of death from COPD and also determine risk for expressed moderate and severe acute exacerbations (Pantazopoulos et al. 2022).

The mean **D-Dimer** level during COVID-19 was higher compared to the post-COVID-19 period. The analysis shows that there is a borderline statistically significant difference ($p=0.054$) in D-Dimer levels during and after COVID-19 infection. The higher mean difference during the period of active infection suggests increased coagulation activity or thrombotic risk during COVID-19. D-dimer has a high negative predictive value for the diagnosis of pulmonary embolism (EP) and can exclude EP in patients with low or intermediate clinical probability of EP, or those classified as unlikely to have EP. Moreover, increased D-dimer levels during follow-up are associated with a higher risk of thrombotic recurrence after discontinuation of anticoagulation (Yousuf et al. 2020).

A hypercoagulable state, which can induce thrombotic coagulopathy such as pulmonary microthrombosis and disseminated intravascular coagulation (DIC), is a common complication of severe COVID-19. In the early stages of COVID-19 disease, virus-induced endothelial damage leads to hypercoagulation with subsequent release of thrombin in the absence of fibrinolysis, thereby increasing D-dimer levels. This level can also be increased due to pulmonary venous thrombosis or hypoxia-induced thrombosis due to hyperviscosity. D-dimer levels are associated with a poor outcome defined as an increased risk of ARDS, intensive care unit admission, and mortality (Teimury et al. 2022).

The mean **urea** level during COVID-19 was higher compared to the post-COVID-19 period. The p-value of 0.071 indicates that the difference in urea levels between the two periods is not statistically significant ($p > 0.05$), although it is close to the significance threshold.

The mean **creatinine** level during COVID-19 was higher compared to the post-COVID-19 period. The p value of 0.333 indicates that the difference in creatinine levels between the two periods is not significant ($p > 0.05$). Among renal function tests, serum urea and creatinine show high

values among critically ill patients. Older age groups have more pronounced increases in serum urea and creatinine. About 25–30% of patients with COVID-19 develop acute renal failure (ARI) as reported by the Italian Report of the "Istituto Superiore di Sanità".

Cardiac injury is a common clinical feature of patients with COVID-19; this can result from SARS--CoV-2 infection as a result of direct and indirect effects on cardiomyocytes, including acute myocardial infarction, heart failure, arrhythmias, myocarditis, sepsis, septic shock, cardiac arrest, and pulmonary embolism (Bairwa et al. 2021).

The mean difference in **AST** levels during and after COVID-19 indicates an increase during COVID-19. The p value of 0.007 indicates that there is a statistically significant difference in AST levels between the two periods ($p < 0.05$). Alteration of biomarkers of hepatocyte damage, such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), bilirubin, and albumin, is a common laboratory finding in patients with COVID-19. However, the underlying mechanism is not fully understood. Although hepatocytes and bile duct epithelial cells express the ACE2 receptor, no altered histopathological features have been detected in such cells in patients with COVID-19. Thus, hepatic failure associated with COVID-19 may be the result of secondary hepatic injury due to administration of hepatotoxic drugs, systemic inflammatory response, hypoxia induced by respiratory distress syndrome (Ketenci et al. 2022).

At the end of these discussions, we can mention some findings and recommendations that derive from our research.

- The findings of this population study differ from general populations due to the underlying chronic respiratory pathologies (COPD, bronchial asthma, chronic bronchitis) affecting the study group. These chronic pathologies induce basic biochemical changes that may influence responses to acute viral infections such as COVID-19. As such, the abnormalities in biochemical parameters observed during and after COVID-19 are predicted to differ from those commonly seen in the general population without pre-existing respiratory disease.
- In almost all biochemical parameters examined, changes were observed during the phase of COVID-19 compared to the period after COVID-19 in patients with chronic respiratory diseases. This highlights the systemic impact of viral infection on biochemical profiles in this vulnerable subgroup of the population.
- Parameters such as CRP (C-Reactive Protein), D-Dimer, AST (Aspartate Aminotransferase) and cholesterol showed statistically significant increases during the COVID-19 phase compared to post-COVID-19. These increases reflect, respectively, the increased inflammatory response, thrombotic risk, hepatic stress and worsening of dyslipidemia during active infection. Such findings highlight the acute physiological disturbances experienced by patients with respiratory pathology during COVID-19, calling for targeted management strategies.

6 CONCLUSION

The findings of this population study differ from general populations due to the underlying chronic respiratory pathologies (COPD, bronchial asthma, chronic bronchitis) affecting the study group. These chronic pathologies induce basic biochemical changes that may influence responses to acute viral infections such as COVID-19. As such, the abnormalities in biochemical parameters observed during and after COVID-19 are predicted to differ from those commonly seen in the general population without pre-existing respiratory disease.

In almost all biochemical parameters examined, changes were observed during the phase of COVID-19 compared to the period after COVID-19 in patients with chronic respiratory diseases. This highlights the systemic impact of viral infection on biochemical profiles in this vulnerable subgroup of the population.

These findings underscore the critical need for integrated respiratory and systemic health management in patients with chronic respiratory disease affected by COVID-19. Tailored interventions that focus on modulation of inflammation, reduction of thrombotic risk, maintenance of hepatic function, and metabolic control are necessary to optimize clinical outcomes and mitigate complications in this vulnerable population subgroup.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

OPOLNOMOČENJE STARŠEV OTROK Z AVTISTIČNO MOTNJO: EARLYBIRD PLUS PROGRAM

EMPOWERING PARENTS OF CHILDREN WITH AUTISM SPECTRUM DISORDERS: THE EARLYBIRD PLUS PROGRAMME

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POVZETEK

EarlyBird Plus (EBP) program predstavlja enega izmed redkih z dokazi podprtih pristopov za opolnomočenje staršev otrok z avtističnimi motnjami (AM). Namen kvantitativne raziskave je bil proučiti napredek staršev vključenih v EarlyBird Plus program s pomočjo APQ (The Autism Parent Questionnaire) vprašalnika na treh vsebinskih sklopih: poznavanje AM, uporaba strategij pomoči (komunikacija in interakcija z otrokom ter obvladovanje vedenja otrok z AM) ter obvladovanje stresa (pogled v prihodnost, optimizem, zaupanje v starševstvo, zaznavanje pomoči, kako avtizem vpliva na njihovo življenje, zadovoljenost potreb vseh družinskih članov). Podatke smo obdelali s pomočjo statističnega programa SPSS 29, pri katerem smo uporabili neparametrični test za odvisne vzorce (Friedmanov oz. Wilcoxonov test). Rezultati so pokazali statistično pomembne razlike na vseh treh sklopih. V prihodnje bi bilo smiselno raziskavo nadgraditi v smeri proučitve širšega konteksta učinkovitosti programa, npr. skozi oceno prilagojenega vedenja otroka z AM, oceno vedenja staršev, nadaljnje spremljanje učinkovitosti programa, proučitev prenosa znanja v druga okolja.

***Ključne besede**: EarlyBird Plus program, opolnomočenje staršev, otroci z avtističnimi motnjami, strategije pomoči, obvladovanje stresa*

ABSTRACT

The EarlyBird Plus (EBP) programme is one of the few structured concepts with evidence-based elements to support parents of children with autism spectrum disorders (ASD). In this quantitative study, parents' progress during their participation in the EBP programme was assessed using the Autism Parent Questionnaire (APQ) in three areas: Knowledge of ASD, use of support strategies, and stress management (including parental confidence, optimism, and overall family well-being). Data were analysed with SPSS 29 using non-parametric tests for dependent samples (Friedman or Wilcoxon). The results showed statistically significant improvements in all three areas. Future research could extend these findings by examining the overall effectiveness of the programme, e.g. by assessing children's adaptive behaviour, parenting practises, longer-term outcomes and transfer of knowledge to other contexts.

***Keywords:** EarlyBird Plus programme, Empowerment of parents, Children with autism spectrum disorders, Support strategies, Stress management*

1 UVOD

Avtistične motnje (AM) so kompleksne razvojno-nevrološke motnje, za katere so značilne pomembne težave na področju socialne komunikacije in interakcije ter prisotnost ozko usmerjenih interesov in aktivnosti (American Psychiatric Association 2013). Omenjene značilnosti pomembno vplivajo na funkcioniranje teh otrok v vseh okoljih in zmanjšujejo njihove prilagoditvene spretnosti. Ob tem pa enako močno, ali še huje, AM vplivajo na funkcioniranje družine. Vzgoja otroka z AM pomeni za družino pogosto tako veliko obremenitev, da to presega njeno sposobnost obvladovanja. Rezultati študij kažejo, da je stres pri starših otrok z avtizmom pomembno večji v primerjavi s starši nevrotipičnih otrok, kot tudi s tistimi, ki imajo otroke z drugimi razvojnimi motnjami (otroci s trisomijo 21, otroci s cerebralno paralizo in/ali otroci z intelektualno manjzmožnostjo) (Hayes and Watson 2013). Posledično imajo starši otrok z AM pogosto težave na področju telesnega in duševnega zdravja, predvsem mame (Dykens et al. 2014; Karst and Van Hecke 2012; Lee et al. 2009; Taylor-Richardson et al. 2006). Že sam diagnostični proces in dogajanje po postavitvi diagnoze je lahko za starše zelo stresno, predvsem, če niso dovolj in na pravi način seznanjeni s stanjem otroka in njegovimi možnostmi za prihodnost. Med drugimi dejavniki, ki so pomembno povezani z njihovim stresom, je predvsem prisotnost vedenjskih težav, ki so pri otroku z avtizmom pogosto prisotne (Estes et al. 2013). Pokazalo se je tudi, da je breme postavljene diagnoze bistveno manjše, če otrok dobi takoj potem ustrezno terapevtsko pomoč in starši lahko spremljajo njegov napredek že na začetku. Pomemben dejavnik za zmanjšanje njihovega stresa ima tudi opolnomočenje s pomočjo izobraževalnih in podpornih programov, ki so namenjeni njim. Sodelovanje v teh programih, kjer starši izboljšajo poznavanje avtizma, se seznanijo z oblikami pomoči in imajo možnost delitve svojih strahov, skrbi in vsakodnevnih izzivov z drugimi udeleženci s podobno izkušnjo, dokazano poveča občutek kontrole, zmanjša stres in izboljša njihovo kvaliteto življenja (Cutress and Muncer 2013), hkrati pa pomembno vpliva na dolgoročne učinke terapevtske obravnave teh otrok (Karst and Van Hecke 2012; Kodrič 2012). Glede na to gre trend v razvoju novih modelov pomoči za otroke z AM v smer čedalje večjega vključevanja staršev oz. družine, od preprostega sodelovanja k vse bolj usmerjenemu usposabljanju in opolnomočenju (Kasari et al. 2010; National Research Council 2001).

2 TEORETIČNA IZHODIŠČA

EarlyBird Plus program (EBP) je licenčni izobraževalni program za starše otrok z AM, starih od 4 do 9 let. Program je bil zasnovan s strani National Autistic Society (NAS), vodilne neprofitne organizacije za AM v Veliki Britaniji, leta 2003. Vanj je bilo do sedaj vključenih že več kot 27.000 družin v 14 državah. V britanski nacionalni zdravstveni službi se pogosto izvaja kot prva vrsta pomoči po diagnosticiranju AM. Namen programa je podpora staršem takoj po prejeti diagnozi njihovega otroka, opolnomočenje ter nudenje pomoči pri uvajanju dobrih praks in strategij doma in v šoli (Dawson-Squibb et al. 2020). Vsebina programa je sestavljena iz elementov, ki izhajajo iz različnih, z dokazi podprtih programov, ki so usmerjeni v izboljšanje kakovosti življenja otrok z AM in njihovih družin (Anderson et al. 2006). Sestoji iz treh temeljnih vsebinskih sklopov: prvi se osredotoča na razumevanje te razvojne motnje ter kako AM vplivajo na razvoj in vedenje otrok. V drugem sklopu se starši seznanijo s tem, kako razvijati socialno interakcijo in komunikacijo s svojim otrokom ter na kakšen način jo podpreti in prilagoditi. V tretjem sklopu pa se starši naučijo analizirati otrokovo vedenje ter prepoznati sprožilce in funkcijo manj prilagojenega vedenja. Poznavanje osnovnih značilnosti, vzrokov in drugih konceptov, povezanih z AM, je temeljni del procesa opolnomočenja in staršem pomaga pri ravnanju s svojim otrokom, kakor tudi v komunikaciji s strokovnjaki, ki ga obravnavajo. Novo pridobljeno znanje ima pomembno vlogo pri funkcioniranju celotne družine in lahko doprinese k boljšemu razpoloženju vseh družinskih članov. Bolje kot starši razumejo AM, bolj učinkoviti so lahko, ko se pojavijo težave njihovih otrok. Na osnovi pridobljenega znanja lažje sprejemajo odločitve, vezane na nadaljnjo obravnavo njihovega otroka.

V sklopu NAS redno evalvirajo učinkovitost implementiranih EBP programov po svetu, z namenom zagotavljanja najvišje ravni kakovosti – tako na organizacijski kot tudi vsebinski ravni modela. Implementacija tovrstnega programa je mogoča le s strani licenčnih strokovnjakov, ki imajo

v ta namen opravljeno ustrezno izobraževanje. Na podlagi kliničnih smernic NCCN za oceno trdnosti dokazov EBP program s postopno vse večjim številom raziskav pridobiva na svoji veljavnosti ter ustreza kriterijem skupine 2B (Dawson-Squibb et al. 2020). Tuji avtorji poročajo o pozitivnih spremembah implementacije EBP programa na različna področja funkcioniranja otrok z AM in posledično tudi boljšega funkcioniranja celotne družine (Birkin et al. 2004; Cutress and Muncer 2013; Stevens and Shields 2013). Pilotna študija (Ziab et al. 2024) specifično kaže, da se EBP program uveljavlja kot model za usposabljanje staršev, ki izboljša počutje otroka in njegove celotne družine. Več kot 84 % staršev (n = 60) je poročalo o boljšem razumevanju AM in pridruženih senzornih težav ter o tem, kako te vplivajo na komunikacijo in življenje njihovega otroka. Podobno je večina staršev (n = 61, ≈87 %) poročala, da so tekom programa pridobili nove strategije za komunikacijo ter obvladovanje vedenjskih izzivov svojega otroka z AM. Več kot 86 % (n = 61) jih je bilo pripravljenih EBP program priporočiti drugim staršem otrok z AM. Udeležba v EBP programu je staršem pomagala predvsem ustvariti podporno okolje za njihove otroke in vzpostaviti boljšo komunikacijo z njimi. Poleg tega jim je zagotovila učinkovite strategije spoprijemanja z izzivi in na splošno izboljšala blaginjo družine. Podobno ugotavljajo tudi v drugi raziskavi, kjer naj bi starši otrok z AM, vključenih v EBP program, ob že zgoraj omenjenih pozitivnih učinkih še posebej cenili možnost srečanja z drugimi starši, s katerimi so lahko delili enake strahove in iskali skupne rešitve (Cutress and Muncer 2013).

Nekateri avtorji poročajo tudi o dolgoročnih učinkih EBP programa na funkcioniranje vključenih družin otrok z AM. Starši, ki so sodelovali v nacionalni študiji v Novi Zelandiji, so po zaključenem EBP programu bolje razumeli AM in osvojili spretnosti, ki so jim pomagale pri procesu učenja ter modifikacije vedenja njihovega otroka. Pridobljeno znanje se je ohranilo vsaj tri mesece po zaključku EBP programa (Birkin et al. 2004; Stevens and Shields 2013). Tako kratkoročni kot tudi dolgoročni pozitivni učinki EBP programa kažejo na vse večjo potrebo po spodbujanju ciljno usmerjenih programov usposabljanja za opolnomočenje staršev otrok z AM v različnih okoljih. Zagotavljanje stalne strokovne in osebne podpore družini na ravni načrtovanja oblik pomoči ter izobraževanja, ki sledi nemudoma po pridobljeni diagnozi AM pri njihovem otroku, je bistvenega pomena za nadaljnjo samostojnost in neodvisnost (Košir et al. 2011).

3 EMPIRIČNA IZHODIŠČA

Cilj

Ocena napredka staršev otrok z AM vključenih v EBP program (primerjava udeležencev pred in po programu).

Raziskovalna vprašanja

Ugotoviti, kako starši otrok z AM pred in po vključitvi v EBP program ocenjujejo:

- Poznavanje AM (razumevanje področja AM)
- Uporaba strategij pomoči (komunikacija ter interakcija z otrokom z AM; obvladovanje vedenja otroka z AM)
- Obvladovanje stresa (pogled v prihodnost; optimizem; zaupanje v starševstvo; zaznavanje pomoči; kako avtizem obvladuje njihovo življenje; zadovoljenost potreb vseh družinskih članov)

Vzorec

V vzorec je bilo vključenih 35 staršev otrok z AM, ki so vodeni v sklopu Inštituta za avtizem, zavoda za razvojno medicino, Ljubljana. Kriterij za vključitev staršev v raziskavo je bila postavljena diagnoza AM pri njihovem otroku ter starostna omejitev (kriterij: 4-9 let). Vključena sta lahko bila oba ali eden od staršev. Obravnava vključenih staršev otrok z AM je potekala na Inštitutu za avtizem in sicer na dveh lokacijah (Maribor, Ljubljana), v času od marca 2023 do decembra 2023 s strani 3 strokovnih delavk z ustrezno pridobljeno licenco za vpeljevanje EBP programa. Starši so k sodelovanju pristopili prostovoljno, prav tako je bila njihova udeležba brezplačna. Raziskava je potekala v sklopu programa "Več zdravja za družine otrok in mladostnikov z avtizmom-VITA", ki ga sofinancira Ministrstvo za zdravje Republike Slovenije kot enega od programov varovanja in krepitve zdravja do l. 2025. Vseskozi je bila zagotovljena anonimnost podatkov. Starši so bili obveščeni, da lahko iz raziskave kadarkoli in brez kakršnihkoli posledic, izstopijo.

Instrumentarij

The Autism Parent Questionnaire (APQ) (Anderson et al. 2006) je vprašalnik za starše otrok z AM, ki je bil razvit kot del ocene licenčne uporabe EBP programa v sklopu National Autistic Society (NAS) na Novi Zelandiji. Vprašalnik je kratek in zanesljiv ter namenjen ugotavljanju učinkovitosti programov zgodnje obravnave za starše (Palmer et al. 2020).

Vprašalnik sestoji iz sedmih komponent, ki prav tako tvorijo posamezna področja vprašalnika (znanje o avtizmu; obvladovanje vedenja; komunikacija/ jezik; zaupanje; obvladovanje stresa; funkcioniranje družine; igra).

Za implementacijo in vrednotenje APQ vprašalnika ni potrebna formalna izobrazba s področja psihologije ali sorodnega področja, prav tako ni potrebno dodatno usposabljanje. Kljub temu je bilo vrednotenje izvedeno s strani kliničnih strokovnjakov. Izpolnjevanje APQ s strani staršev je trajalo približno 10 minut, časovna omejitev za izpolnjevanje ni bila določena.

Starši otrok z AM so vprašalnik izpolnili tik pred pričetkom izvedbe EBP programa, prav tako so vprašalnik izpolnili takoj po njegovem zaključku. Pridobljene rezultate APQ vprašalnika smo v nadaljevanju interpretirali in jih razložili skozi način ocene napredka staršev otrok z AM vključenih v EBP program. Rezultate udeležencev pred procesom vključitve in tik po njegovem zaključku smo v nadaljevanju primerjali med seboj. Sodelovanje je bilo prostovoljno, pri čemer smo vsem udeležencem zagotovili anonimnosti pri obravnavi njihovih odgovorov.

S spodnjo preglednico 1 ponazarjamo vrednotenje APQ vprašalnika z najvišjim ter najnižjim rezultatom lestvice po posameznih postavkah.Višji rezultat na posameznem področju pomeni bolj opolnomočenega starša, med tem ko nižji rezultat pomeni ravno nasprotno in nakazuje, da ima starš na tem področju več izzivov oziroma težav. Skupna ocena predstavlja splošen prikaz opolnomočenosti staršev otrok z AM.

Tabela 1: Vrednotenje APQ vprašalnika z najvišjim in najnižjim rezultatom lestvice

Področja	Postavka	Najnižji – najvišji rezultat
Znanje	1 - 4	4 – 24
Veščine komunikacije	5 - 8	4 – 24
Igra	9 – 11	4 – 24
Obvladovanje vedenja	12 – 15	3 – 18
Stres	16 – 19	3 – 18
Zaupanje	20 – 22	4 – 24
Funkcioniranje družine	23 – 25	3 – 18
Skupna vrednost	1 - 25	- 150

Zaradi lažje interpretacije rezultatov v nadaljevanju smo posamezna področja združili v tri glavne kategorije v sklopu katerih smo primerjali ocene staršev pred in po EBP programu in evalvirali njegovo učinkovitost:

- Poznavanje AM (znanje)
- Uporaba strategij pomoči (veščine komunikacije, igra, obvladovanje vedenja)
- Obvladovanje stresa (stres, zaupanje, funkcioniranje družine)

Obdelava podatkov

Podatke smo obdelali s statističnim programom SPSS 29 za Windows 11. Uporabili smo naslednjo statistično metodo:

- Neparametrični test za odvisne vzorce (Friedmanov oz. Wilcoxonov test) za ugotavljanje razlik v aritmetičnih sredinah spremenljivk pri isti skupini merjencev, če je posamezna spremenljivka statistično značilno odstopala od normalne porazdelitve.

Rezultati

Analiza pred in po zaključku EBP programa

Glavni namen vprašalnika APQ je bil oceniti napredek staršev otrok z AM vključenih v EBP program (primerjava udeležencev pred in po programu). Odgovori udeležencev EBP programa so bili uporabljeni za analizo občutljivosti posameznih področij APQ vprašalnika na spremembe pred začetkom in po zaključku EBP programa.

Rezultati Wilcoxonovih testov na podatkih iz vprašalnikov pred in po izpolnitvi (N = 35) kažejo, da je skupina staršev otrok z AM po zaključenem EBP programu v primerjavi z rezultati pred vključitvijo v program dosegla pomemben napredek na vseh treh kategorijah področij EBP programa (raven poznavanja AM, uporabe strategij pomoči, obvladovanje stresa). Na osnovi neparametričnega testa za odvisne vzorce (alfa = 0.05; 95 % stopnja zaupanja) se je izkazalo, da so razlike na vseh treh kategorijah statistično pomembne.

Opisni podatki staršev vključenih v EBP program (pred vključitvijo in po zaključenem programu) so v nadaljevanju prikazani v preglednici št. 2 in na grafu št. 1.

Tabela 2: Srednja vrednost ter standardni odklon v sklopu analize APQ vprašalnika pred in po zaključku EBP programa vključenih staršev otrok z AM

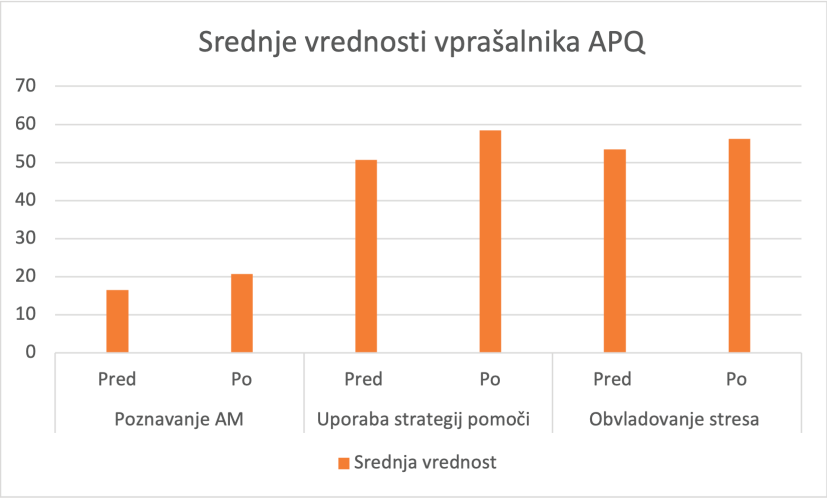
Kategorije		*Št. udeležencev*	Srednja vrednost	Standardni odklon
Poznavanje AM	Pred	35	16,42	3,432
	Po	35	20,74	2,873
Uporaba strategij pomoči	Pred	35	50,65	8,901
	Po	35	58,40	6,404
Obvladovanje stresa	Pred	35	53,48	7,472
	Po	35	56,20	6,057

Rezultati so pokazali višjo raven raven poznavanja AM po zaključenem EBP programu s strani staršev, ki zajema izboljšanje njihovega razumevanja specifičnih značilnosti AM, na osnovi katerih njihovi otroci z AM odstopajo od otrok z običajnim razvojem.

Starši so po zaključenem EBP programu napredovali na področju uporabe strategij pomoči do otrok z AM. To področje zajema načine s katerimi so starši izboljšali svojo komunikacijo do otrok z AM. Prav tako zajema opolnomočenost staršev pri uporabi področja igre z namenom spodbujanja interakcije s svojimi otroki z AM. Del kategorije uporabe strategij pomoči do otrok z AM s strani staršev zajema tudi napredek na področju obvladovanja vedenje svojih otrok z AM, predvsem v smislu boljše opremljenosti s strategijami prepoznavanja, analize in preoblikovanja neželenega vedenja v socialno sprejemljivejše.

Rezultati po zaključenem EBP programu so prav tako pokazali pomemben napredek na področju obvladovanja stresa s strani staršev, predvsem v smislu kako AM obvladujejo njihovo življenje. Okrepila se je njihova samozavest glede na pogled v prihodnost, povečala se je stopnja optimizma ter zaupanja v samo starševstvo.

Graf 1: Srednje vrednosti izbranih kategorij vprašalnika APQ pred in po zaključku EBP programa vključenih staršev otrok z AM



Graf št. 1 prikazuje povprečne rezultate staršev otrok z AM na vsaki od treh kategorij vprašalnika APQ v času pred začetkom EBP programa in po njegovem zaključku. Na vseh treh kategorijah se kaže znatno izboljšanje po zaključenem programu. Vse kategorije (poznavanje AM, uporaba strategij pomoči, obvladovanje stresa) kažejo občutljivost na spremembe.

Ker so bile razlike na vseh treh področij kategorij statistično pomembne, to kaže, da EBP program pozitivno vpliva na raven poznavanja AM, uporabe strategij pomoči ter obvladovanje stresa pri starših otrok z AM.

4 RAZPRAVA

Namen študije je bil oceniti napredek staršev otrok z AM, ki so bili vključeni v EBP program in sicer s primerjavo njihovega poznavanja področja AM, uporabo strategij pomoči ter obvladovanje stresa pred in po vključitvi v omenjeni program. Rezultati so pokazali statistično pomembne razlike na vseh treh področjih omenjenih kategorij. Kljub temu je pomembno poudariti, da je za trajnost teh učinkov potrebna dodatna podpora in dolgoročno spremljanje, saj zgolj kratkoročni napredek ne zagotavlja nujno dolgoročnih sprememb v vedenju in počutju staršev.

V sklopu prvega področja, ki ga je zajel vprašalnik, so starši pokazali višjo raven poznavanja AM, in sicer se je izboljšalo predvsem razumevanje specifičnih značilnosti AM. To je skladno z ugotovitvami Cutress in Muncer (2013), ki prav tako izpostavljata pomen izobraževanja staršev vključenih v EBP za izboljšanje njihovega razumevanja avtizma, izboljšanje komunikacije z otrokom in njihovih sposobnostih obvladovanja otrokovega vedenja. Pomembno je, da starši ne pridobijo le osnovnega znanja, ampak ga znajo tudi uporabiti v vsakdanjih situacijah, saj le tako lahko učinkovito prilagajajo svoj pristop v vzgoji in ustrezno podprejo otroka. Še vedno je malo znanega o tem v kolikšni meri starši novo pridobljeno znanje zmorejo integrirati v vsakdanje življenje in kako to dolgoročno vpliva na razvoj njihovega otroka.

V sklopu drugega področja so rezultati pokazali boljšo uporabo strategij pomoči po zaključenem EBP programu s strani staršev na področju komunikacije, interakcije ter prav tako pri samem procesu obvladovanja vedenja otroka z AM, kar ugotavljajo tudi drugi (Cutress and Muncer 2013; Ziab et al. 2024). Bolj kot specifična klinična simptomatika na stopnjo stresa staršev otrok z AM vplivajo težave, ki jih imajo otroci na vedenjski ravni (Estes et al. 2013). Te pa pomembno vplivajo na kvaliteto njihovega življenja (Øien and Eisemann 2015) ter se dotaknejo celotne družine (Greeff and Walt 2010). Prednost EBP programa v primerjavi z nekaterimi drugimi programi, ki so namenjeni staršem otrok z AM, je, da je vsebinsko celostno zastavljen in se dotakne tudi področja

vedenja. Starši, ki so opolnomočeni na tem področju, bolje razumejo vedenjske izzive svojih otrok in jih lažje obvladajo (Di Renzo et al. 2020). Je pa potrebno izpostaviti, da trenutna študija ne ocenjuje neposrednih sprememb otrokovega vedenja, kar bi lahko pomembno dopolnilo razumevanje učinkovitosti EBP programa. V nadaljnih raziskavah bi bilo smiselno vključiti tudi ocene otrokovega vedenja.

V sklopu tretjega področja se je pokazalo, da starši po zaključenem EBP programu bolje obvladujejo stres in sicer v smislu večjega optimizma, zaupanja v starševstvo, zaznavanja pomoči, pogleda v prihodnost, načina, kako avtizem obvladuje njihovo življenje ter zadovoljenosti potreb družinskih članov. Slednje je izjemnega pomena, saj raziskave kažejo, da so starši otrok z AM izpostavljeni višjim ravnem stresa in nižji kakovosti življenja v primerjavi s starši nevrotipičnih otrok in starši otrok z drugimi razvojnimi motnjami (Hayes and Watson 2013; Meadan et al. 2010; Ni'matuzahron et al. 2021). Pomembno je, da programi, kot je EBP, niso osredotočeni zgolj v podajanje informacij staršem, temveč tudi v čustveno in socialno podporo, ki pomaga staršem vzdrževati dobro duševno zdravje in obvladovati izzive vsakdana. Z longitudinalnimi študijami bi bilo koristno dolgoročno spremljanje učinkov povezanih z obvladovanjem stresa in morebitni dodatni podpori za vzdrževanje le tega.

V Sloveniji smo v zadnjih dveh desetletjih napredovali na področju diagnostike in obravnave za otroke z AM, medtem ko smo bili na začetku glede programov pomoči za njihove starše. Programi podpore zanje naj bi se izvajali čim prej po prejeti diagnozi, ne samo zato, da bi se zmanjšal stres, temveč tudi zato, da bi starši dobili pomoč pri obvladovanju vedenja njihovega otroka, še preden ta utrdi neželene vzorce (Cutress and Muncer 2013). Med uspešnejšimi večjimi projekti v preteklosti na področju podpore staršem je bil projekt ZORA (Več zdravja za otroke in mladostnike z avtizmom in njihove družine), sofinanciran s pomočjo Norveškega finančnega mehanizma 2009-2014, v sklopu katerega se je v Sloveniji prvič implementiral EBP program. Izkušnje iz projekta ZORA, ki je omogočil implementacijo EBP programa, kažejo na možnost širše uporabe takšnih programov kot del rutinske podpore staršem v Sloveniji.

Opolnomočenost na področju komunikacije in interakcije, ki so jo starši deležni v okviru EBP programa, pomembno vpliva na razvoj otroka (Clifford and Dissanayake 2009; Haebig et al. 2013; Siller and Sigman 2008). Med bolj znanimi tujimi modeli, ki se osredotočajo na področje komunikacije in interakcije, je program More than Words (Več kot besede), ki so ga razvili v sklopu Hanen centra in ki se tudi že izvaja v Sloveniji za otroke z AM. Z uporabo praktičnih strategij in pristopov v vsakdanjem življenju spodbuja komunikacijo med starši in otrokom (Pillay et al. 2011). V primerjavi z EBP programom je vsebinsko ožje usmerjen, eksplicitno bolj v področje socialne komunikacije in interakcije in se v nekoliko manjši meri dotakne področja razumevanja in modifikacije vedenja.

Med empirično utemeljenimi modeli za starše otrok z AM, ki se izvajajo v sklopu našega zdravstvenega sistema, bi lahko izpostavili program Neverjetna leta, ki ga je razvila dr. Carolyn Webster-Stratton, profesorica psihologije in strokovnjakinja na področju otroškega razvoja in klinične psihologije (Webster-Stratton 2016). Ena od različic programa je prilagojena za starše predšolskih otrok z AM in zaostankom govora, starih od 2 do 5 let. Program ponuja strategije za spodbujanje komunikacijskih veščin, socialnih interakcij, samoregulacije in vedenjskega razvoja pri teh otrocih ter nudi podporo staršem pri njihovi vlogi. Vsebinsko sovpada z EBP programom, medtem ko v nasprotju z njim vključuje ožjo ciljno skupino udeležencev (Neverjetna leta: 2–5 let, EBP program: 4–9 let) ter je časovno bolj obsežen. Ob tem ne omogoča osebne izkušnje obiska družine na domu s strani strokovnjaka, kar je lahko ključnega pomena za izmenjavo vprašanj in idej ter prilagajanje informacij posameznim družinam (Stevens and Shields 2013).

Med najbolj učinkovitimi in poznanimi programi za starše v svetu s področja vedenja bi lahko izpostavili Triple P – Positive Parenting Program. Staršem nudi preproste in praktične strategije, ki jim pomagajo zgraditi močan in zdrav odnos ter obvladovati vedenje otroka oziroma jim pomagajo preprečiti nastanek morebitnih težav (Triple P Introductory Guide 2022). V primerjavi s Triple P je EBP program tako vsebinsko kot tudi organizacijsko specifično prilagojen staršem otrok z AM. Triple P program pa je v nasprotju s tem splošno zastavljen in velja kot podpora za starše v smislu spoznavanja univerzalnih strategij za preprečevanje vedenjskih in čustvenih težav otrok z motnjami v razvoju. Triple P program v slovenskem prostoru še ni bil implementiran.

Študij, ki bi preverjale učinkovitost različnih programov usmerjenih v podporo za starše otrok z AM, je še vedno relativno malo. Med seboj se tudi razlikujejo tako po metodologiji kot vsebinskih vprašanjih, kot tudi načinu preverjanja učinkovitosti, zato je primerjava med njimi otežena. Nadaljnje raziskave z vidika poglobljene proučitve učinkovitosti staršem usmerjenih pristopov, kot je EBP program, bi predstavljale neprecenljiv vir za optimalno realizacijo opolnomočenja družin otrok z AM po vsem svetu (Dawson-Squibb et al. 2020). Nadaljnje raziskave bi tako lahko prispevale k boljšemu razumevanju, kateri elementi programov so najbolj učinkoviti in kako jih prilagoditi posameznim družinam.

Načrtovanje in izvajanje podpornih programov (kot je EBP program) za starše otrok z AM v prihodnosti lahko predstavlja eno od možnosti, da se s težavami soočajo bolj strateško in izboljšajo kakovost družinskega življenja (Hosseinpour et al. 2022). Breme postavljene diagnoze je bistveno manjše, če otrok ustrezno terapevtsko pomoč dobi takoj potem in starši lahko spremljajo njegov napredek že na začetku. Možnost za vključitev v EBP program bi morala dobiti vsaka družina po tem, ko se diagnostika pri njihovem otroku zaključi. Kot navajajo tuji avtorji, udeležba staršev otrok z AM v izobraževalnih modelih, kot je EBP program, družinam pomaga ustvariti podporno okolje, jim zagotovi učinkovite strategije za spoprijemanje z izzivi ter na splošno izboljša blaginjo življenja (Cutress and Muncer 2013; Ziab et al. 2024).

5 ZAKLJUČEK

Družine otrok z AM se soočajo z velikimi izzivi na področju učenja, socializacije ter vedenja. Težave otrok z AM na omenjenih področjih pomembno vplivajo na njihovo družinsko življenje. V starše usmerjeni modeli pomoči, ki družino celostno obravnavajo, so se izkazali kot učinkovit način za zmanjšanje njihovih težav. EBP program predstavlja enega izmed učinkovitih izobraževalnih programov, ki opolnomoči starše otrok z AM. S tem, ko temelji na treh prepletajočih se predpostavkah (avtizem, komunikacija in vedenje), staršem otrok z AM pomaga, da se lažje soočijo z izzivi, ki jih imajo v vsakodnevnem življenju. Izvajanje EBP programa v našem javnem zdravstvenem sistemu, ki bi bil dostopen vsem staršem ter zanje brezplačen, bi bil nujno potreben. Skupine za opolnomočenje staršev niso alternativa individualni terapiji otroka, ampak njena nadgradnja. V prihodnje bi bilo smiselno učinkovitost EBP programa še bolj poglobljeno proučiti in raziskavo razširiti na naslednje načine:

- Poglobljeno vrednotenje učinkovitosti intervencijskega programa skozi vidik prilagojenega vedenja otroka z AM pred in po zaključku EBP programa s pomočjo uveljavljenih instrumentarijev (kot npr. Vinelandska lestvica vedenja).
- Dolgoročno spremljanje učinkovitosti EBP programa po njegovem zaključku (npr. po 3 mesecih, po 6 mesecih; EarlyBird Plus Follow-up questionnaire).
- Proučitev opolnomočenosti pridruženih članov (npr. starih staršev in/ali strokovnih delavcev) v EBP program z vidika transferja znanja v druga okolja (dom starih staršev, vzgojno izobraževalna institucija) z namenom čim večje konsistentnosti dela z otrokom z AM.

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1.08 Objavljeni znanstveni prispevek na konferenci
Published scientific conference contribution

DEJAVNIKI TVEGANJA, KI VODIJO DO NAPAK PRI ZDRAVILIH IN STRATEGIJE ZA NJIHOVO PREPREČEVANJE V SLOVENSKI SPLOŠNI BOLNIŠNICI

RISK FACTORS LEADING TO MEDICATION ERRORS AND STRATEGIES FOR THEIR PREVENTION IN A SLOVENIAN GENERAL HOSPITAL

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POVZETEK

Uvod: *Prepoznavanje napak, ki se lahko pojavijo pri rokovanju z zdravili, je ključno za preprečevanje neugodnih posledic tako za pacienta kot za zdravstvenega delavca. Namen raziskave je bil ugotoviti stališča zaposlenih v Splošni bolnišnici Murska Sobota o dejavnikih tveganja, ki privedejo do morebitnih napak, preveriti uporabo strategij za zmanjševanje le teh ter seznanjenost zaposlenih s sistemom za sporočanje neželenih dogodkov. Metode: Za teoretični del naloge se je uporabilo kvalitativno metodologijo dela s pomočjo iskanja podatkov na omenjeno tematiko, s pomočjo domačih in tujih podatkovnih baz. Za raziskovalni del pa se je izvedla presečno epidemiološka raziskava med zaposlenimi v Splošni bolnišnici Murska Sobota. Podatki so bili obdelani s pomočjo računalniških programov Microsoft Word, Microsoft Excel in IBM SPSS 22. Rezultati: Rezultati raziskave so pokazali, da sodelujoči v raziskavi kot največji dejavnik tveganja za pojav napak opredeljujejo nečitljiv zapis terapije na temperaturnem listu. Med strategijami, ki jih zaposleni uporabljajo za zmanjšanje napak, so: upoštevanje pravila 10P, ustreznost delovnih prostorov ter seznanjenost s sistemom za poročanje neželenih dogodkov. Menijo, da bi elektronski temperaturni list pripomogel k zmanjšanju napak, predvsem v smislu čitljivosti. Razprava: Prav tako kot po drugih bolnišnicah si tudi zdravstveni delavci v tej ustanovi želijo varno in kakovostno ter ne obsojajočo delovno klimo. Seznanjeni so tudi s sistemom za sporočanje napak. Menijo, da se je o napakah potrebno pogovarjati, saj se na tak način zmanjšajo strahovi glede sporočanja napak o neželenih dogodkih v povezavi z rokovanjem z zdravili.*

Ključne besede: *rokovanje z zdravili, napake, vzroki, medicinske sestre, poročanje napak*

ABSTRACT

Introduction: The identification of errors that may occur during medication handling is crucial for preventing adverse outcomes for both patients and healthcare professionals. The aim of the study was to examine the attitudes of employees at Murska Sobota General Hospital toward risk factors that may lead to medication errors, to examine the use of strategies for reducing such errors and employees' familiarity with the adverse event reporting system. Methods: The theoretical part of the study was based on a qualitative methodology using a review of relevant literature from national and international databases. The empirical part consisted of a cross-sectional epidemiological study conducted among employees of Murska Sobota General Hospital. Data were processed using Microsoft Word, Microsoft Excel, and IBM SPSS version 22. Results: The results showed that participants identified illegible medication orders on the temperature chart as the most significant risk factor for medication errors. The strategies used by staff to reduce errors included adherence to the "10 rights" (10P) of medication administration, appropriate working conditions, and familiarity with the adverse event reporting system. Respondents believed that an electronic temperature chart would help reduce errors, primarily by improving legibility. Discussion: As in other hospitals, healthcare professionals in this institution seek a safe, high-quality, and non-punitive working environment. They are familiar with the error-reporting system and believe that discussing errors is essential, as it reduces fear associated with reporting medication-related adverse events.

Keywords: *Medication handling, Errors, Causes, Nurses, Error reporting*

1 UVOD

Škrab in Mlinar (2021) sta mnenja, da so najpogostejši neželeni dogodek v času hospitalizacije prav napake, ki so povezane z ravnanjem z zdravili. Medicinske sestre so s tem tesno povezane, kajti prav one so tiste, ki vsakodnevno pripravljajo zdravila po naročilu zdravnika in jih tudi aplicirajo pacientu. Robida (2013) navaja, da se napake v zdravstvu delijo na aktivne in latentne napake. Ko človek naredi napako, je ta takoj vidna, je tako imenovana aktivna napaka, med tem ko je večina vzrokov latentnih (80-90%), tj. skritih v procesih in sistemih. Le 10-20% napak je takih, ki jih povzroči posameznik.

Z vidika hitrega razvoja medicine so nujno potrebna raziskovanja s področja rokovanja z zdravili. Rezultati tovrstnih raziskav nam bodo podali odgovore, kako lahko na področju kakovosti znatno vplivamo na zmanjšanje stroškov povezanih s škodo, ki se lahko povzroči pacientom v času zdravstvene obravnave. Rokovanje z zdravili obravnavamo rutinsko. Zaradi tega tudi določene intervencije izvajamo preveč avtomatizirano, posledica tega pa so tudi prevelike obremenitve v samem procesu dela. Vse to vodi do napak pri rokovanju z zdravili. Tako posamezniki kot tudi družba si želimo kakovostnih storitev in zagotovitev varnosti.

Cilj, da se oceni škoda, ki je bila povzročena z zdravili, da se oceni tudi njen obseg, obenem pa cilj oblikovanja primernejših orodij, ki bi naj podpirala varno uporabo zdravil ter izoblikovanje ustreznih smernic, je bil povezan s tretjim globalnim izzivom SZO. Ta je SZO spodbudil k priznavanju negativnih dejavnikov, ki bi naj vplivali na zdravje pacientov (Teeteh 2019). Kramar (2022) navaja, da za varno in kakovostno ravnanje z zdravili vsaka zdravstvena organizacija potrebuje ustrezno kompetentno zdravstveno osebje, izoblikovana in jasna navodila s strani farmacevtov in zdravnikov, strokovne nadzore, ustrezno delovno okolje in drugo.

Določeno zdravilo lahko prinese precejšnjo škodo, če pride do nepravilnega zaužitja, nepravilnega nadzorovanja zdravil ali pa enostavno kot posledica nekih napak oziroma nepravilnega ravnanja (WHO 2017). Pomembno vlogo pri zagotavljanju varnosti pacientov imajo medicinske sestre, kajti one so tiste, ki ob pacientu preživijo bistveno več časa na dan kot zdravniki. Naloga zdravnikov je usmerjena predvsem v diagnostiko in samo zdravljenje, medicinske sestre pa stalno prisostvujejo pacientu, sodelujejo s farmacevti, zdravniki, ostalimi člani zdravstvenega tima ter s svojci pacienta. Pacienta ves čas spremljajo in poročajo o pacientovem zdravstvenem stanju (Phillips idr. 2021). Robida (2009, 75) navaja, da so pacienti ključni za to, da zdravstvo obstaja, prav tako kot različni zdravstveni strokovnjaki, ki delajo zanje. S tem pa je povezan tudi obstoj zdravstvenih ustanov.

Medicinske sestre so v svoji praksi velikokrat »primorane« presegati svoje kompetence. Pri vsem tem pa se morajo zavedati svojih pristojnosti, ki izhajajo iz pravic do odločanja, ter s tem povezane odgovornosti. V takšnih primerih se pogosto postavi v ospredje vprašanja kompetenc in obenem odgovornosti (Beguš 2016).

1.1 Namen in cilji

Namen raziskave je bil ugotoviti stališča zaposlenih v Splošni bolnišnici Murska Sobota (SBMS) o dejavnikih tveganja, ki privedejo do napak pri rokovanju z zdravili. Raziskujemo, v kolikšni meri zdravstveni delavci prepoznajo napake, ki se pojavijo pri rokovanju z zdravili, in kateri dejavniki najbolj vplivajo na pojav le teh. Cilj raziskave je predstaviti najpogostejše dejavnike, ki vplivajo na napake pri rokovanju z zdravili. Pomemben del predstavlja tudi odnos zdravstvenih delavcev do sporočanja napak v zvezi z rokovanjem z zdravili. Ugotoviti je bilo potrebno, v kolikšni meri zdravstveni delavci v SBMS prepoznajo moteče dejavnike, ki vplivajo na napake, povezane z rokovanjem z zdravili. Zanimalo nas je tudi, ali imajo tamkajšnji zaposleni zagotovljene ustrezne prostore za pripravo zdravil. Želeli smo ugotoviti tudi to, ali zaposleni v SBMS menijo, da bi uporaba e-temperaturnega lista znatno doprinesla k zmanjševanju napak povezanih z rokovanjem z zdravili. Kot zadnje pa smo želeli ugotoviti, ali zaposleni v tej ustanovi uporabljajo vsaj nekatera priporočila za zmanjševanje napak, povezanih z rokovanjem z zdravili. Glede na to smo izoblikovali dve raziskovalni vprašanji in štiri hipoteze:

R1: Kateri so tisti dejavniki, ki so po mnenju zaposlenih najbolj izpostavljeni kot vzrok za nastanek napak pri rokovanju z zdravili?

R2: Katere strategije se že uporabljajo v SBMS za zmanjševanje napak, povezanih z rokovanjem z zdravili?

H1: Po mnenju anketiranih nemirno in hrupno okolje kot tudi ne zbranost pri delu statistično značilno vpliva na napake, ki se pojavijo pri rokovanju z zdravili.

H2: Zaposleni, ki so starejši od 40 let, in opravljajo večizmensko delo, so mnenja, da je statistično značilno najbolj moteč dejavnik preobremenjenost medicinske sestre, mlajši zaposleni pa so mnenja, da na napake najbolj vpliva neizkušenost le-teh.

H3: Prisotnost kliničnega farmacevta moti delovni proces in ne pripomore k varnejši oskrbi pacientov na oddelku.

H4: Strah pred izgubo službe ali obsojanje sodelavcev po mnenju anketiranih vpliva na nepriznavanje napak pri rokovanju z zdravili.

2 METODE

2.1 Metode in tehnike zbiranja podatkov

Raziskava temelji na kvalitativni in kvantitativni metodologiji dela. V okviru kvalitativnega dela raziskave smo iskali podatke na omenjeno tematiko s pomočjo domačih in tujih podatkovnih baz. Za kvantitativni del raziskave pa smo izvedli presečno epidemiološko raziskavo med zaposlenimi v SBMS. Te podatke smo pridobili s pomočjo anketiranja, nakar smo jih analizirali ter prikazali tako v pisni obliki kot v obliki grafov oziroma tabel.

2.2 Opis raziskovalnega instrumenta

Raziskavo smo izvedli s pomočjo anonimnega anketnega vprašalnika. Sodelovanje v anketi je bilo prostovoljno. Vprašalnik je zajemal 30 s to tematiko povezanih vprašanj. Prvi del se je nanašal na demografske podatke in na podatke, kje so posamezniki zaposleni ter kakšno vrsto dela opravljajo. Drugi del je zajemal vprašanja o rokovanju z zdravili, vključno z dejavniki, ki vplivajo na napake, ki se lahko ob tem pojavijo. Zaključni, tretji del pa se je nanašal na področje varnega rokovanja z zdravili ter seznanjenost z obveščanjem in prijavo napak, ki se lahko ob tem pojavijo. Večina vprašanj je bilo zaprtega tipa, kar omogoča hitrejši pregled zbranih podatkov ter poda okvirno sliko raziskovalnega problema. Anketo smo z namenom, da preizkusimo razumevanje vsebine anketnega vprašalnika, validirali s strani nekaj sodelavcev. Vprašanja za anketni vprašalnik smo oblikovali na osnovi teoretičnih podlag ter izkušenj iz prakse.

2.3 Opis raziskovalnega vzorca

Ciljna populacijska skupina, ki smo jo povabili k sodelovanju v raziskavi, so bili zaposleni zdravstveni delavci SBMS, natančneje tisti zaposleni oziroma zaposlene, ki v večji meri rokujejo z zdravili, tj. načrtujejo, pripravljajo in izvajajo aplikacijo zdravil. 15 oddelkov SBMS je bilo povabljenih k prostovoljnemu sodelovanju. Razdeljenih je bilo 150 vprašalnikov, vrnjenih pa 133. V raziskavi je sodelovalo 76,2% žensk in 31% moških, največ zaposlenih je bilo v starostni skupini 31-40 let; tj. 35,3%, sledijo zaposleni med 20-30 let in sicer 33,1% zaposlenih. Največji delež sodelujočih v anketi predstavlja osebje internega oddelka (18,8%). Kar se tiče trajanja delovne dobe, so največji delež (32,3%) predstavljali zaposleni, ki so v ustanovi zaposleni do 5 let. Sledijo tisti, ki so zaposleni 11-20 let (26,3%). Glede izobrazbe pa največji delež sodelujočih predstavljajo diplomirane medicinske sestre/zdravstveniki, in sicer 55,6%. Večina sodelujočih v anketi zavzema položaj sobnih sester (84,2%). Sodelujoči v raziskavi v veliki meri opravljajo triizmensko delo (57,9%).

2.4 Opis zbiranja in obdelave podatkov

Zdravstveno ustanovo (SBMS) smo zaprosili za dovoljenje za izvedbo raziskave z anketiranjem zaposlenih. Seznanili smo jih z namenom same izvedbe raziskave ter predstavili način njene izvedbe. Po pridobljenem soglasju ustanove smo se po predhodnem dogovoru z odgovornimi dogovorili za začetek anketiranja. Raziskava je potekala v mesecu marcu in aprilu 2024. Analiza podatkov je bila izvedena s pomočjo računalniških programov Microsoft Word, Micro-

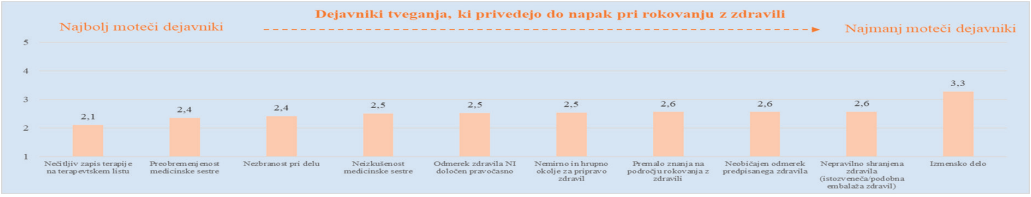
soft Excel in IBM SPSS 22. Rezultate smo nato skrbno ter poglobljeno pregledali, analizirali, interpretirali ter primerjali s predhodno opravljenimi raziskavami, jih med seboj primerjali ter navsezadnje tudi povzeli zaključek tega raziskovalnega dela. Statistično značilnost smo upoštevali na ravni $p < 0,05$.

3 REZULTATI

V raziskavo je bilo vključenih 133 anketirancev. Veliko večino predstavlja ženska populacija, 76,6%, kar torej predstavlja več kot polovico sodelujočih v raziskavi. Veliko zaposlenih je mlajših od 40 let, kar smo tudi predvidevali. Iz tega smo sklepali, da imajo za seboj krajšo delovno dobo, kar so potrdili tudi rezultati raziskave. 57,9% v raziskavi sodelujočih zaposlenih opravlja triizmensko delo, v katero je zajeto tudi opravljanje nočne izmene.

V prvem raziskovalnem vprašanju smo izpostavili dejavnike, ki utegnejo privesti do napak pri rokovanju z zdravili. Najvišjo povprečno vrednost (na lestvici od 1 – najbolj moteči; do 5 – najmanj moteči) je dosegel dejavnik opravljanja izmenskega dela, ki je torej po mnenju anketiranih najmanj moteč (3,28), kot najbolj motečega, s povprečno vrednostjo 2,10, pa so sodelujoči označili nečitljiv zapis na temperaturnem listu. Za omenjeni nečitljivi zapis menijo, da lahko v največji meri prispeva k pojavu napak pri rokovanju z zdravili. Rezultate lahko povežemo s sklepom, da je pravilno in jasno zapisana terapija na temperaturnem listu izjemnega pomena.

Graf 1: Dejavniki tveganja, ki privedejo do napak, pri rokovanju z zdravili



(Vir: Lasten vir 2024.)

Prav tako smo pri H1 primerjali statistično značilni vpliv nemirnega in hrupnega okolja ter nezbranosti pri delu na nastanek napak pri rokovanju z zdravili. Ugotovili smo, da imata ta dva moteča dejavnika pomemben vpliv na pojavnost napak pri rokovanju z zdravili. Kot prikazujejo rezultati v grafu 1, smo to hipotezo tudi potrdili. Če pa se še nekoliko bolj poglobimo v razpravo o H1, smo z regresijsko analizo ugotovili, da na napake vplivajo tudi drugi dejavniki. Pri tej vrsti analize sta prišla do izraza vpliv delovne klime in nadzor nad zdravili, ki na pojav napak pri rokovanju z zdravili vplivata bolj izrazito kot nemirno in hrupno okolje ter nezbranost pri delu. Ugotovili smo tudi, da s pogostejšim nadzorom nad zdravili prihaja do manj motenj pri sami pripravi le-teh ter do doslednejšega upoštevanja pravila 10 P-jev, kar posledično vodi do zmanjševanja napak, ki se lahko ob tem pojavijo. Če pravila upoštevamo dovolj natančno, do napak ne bi smelo priti.

Graf 2: Razlike glede starostnih skupin v primerjavi s pojavnostjo napak pri rokovanju z zdravili

(Vir: Lasten vir 2024.)

Op.: Vprašanje: S pomočjo 5-stopenjske lestvice ocenite, kateri so po vašem mnenju tisti dejavniki, ki se lahko pojavijo pri rokovanju z zdravili in kako moteči so. Lestvica: 1 - najbolj moteč dejavnik / 5 – najmanj moteč dejavnik

Kar se tiče H2, ki zadeva vpliv preobremenjenosti medicinskih sester in neizkušenost le-teh na pojavnost napak pri rokovanju z zdravili, v obeh primerjanih starostnih skupinah (nad 40 let in pod 40 let) ni statistično značilnih razlik, kar lahko vidimo tudi v grafu 2.

Drugo raziskovalno vprašanje se nanaša na področje strategij, ki obravnavajo področja varnega rokovanja z zdravili. Ugotoviti smo želeli, katerih strategij se že poslužujejo v Splošni bolnišnici Murska Sobota. Med te strategije med drugim spadajo: upoštevanje pravil 10P, ločeni prostori za rokovanje z zdravili, uporaba zaščitnih sredstev, dvojno preverjanje zdravil, sodelovanje kliničnega farmacevta na oddelku, sporočanje napak povezanih z rokovanjem z zdravili v sistem za poročanje neželenih dogodkov. Visok odstotek sodelujočih v raziskavi je potrdilo, da pri izvajanju teh nalog vedno upošteva pravilo 10P, kar 55,6%. Zanimivo bi bilo izvesti opazovalno študijo v sodelovanju s kliničnimi farmacevti. Uporaba zaščitnih sredstev pri rokovanju z zdravili ni najbolj natančno opredeljena, saj je večina sodelujočih odgovorila, da ne uporabljajo ničesar od navedenega, vendar pa so ročno pripisali, da pa vseeno uporabljajo zaščitno masko, v 54,1%. Glede uporabe dvojnega preverjanja zdravil so rezultati v izvedeni raziskavi sorazmerno podobni. 51,1% sodelujočih pravi, da dvojno preverjanje uporabljajo, 48,9% sodelujočih pa dvojno preverjanje zanika. Iz rezultatov lahko sklepamo, da med uporabniki še ni natančnih opredelitev glede dvojnega preverjanja zdravil. Dvojno preverjanje zdravil je v bolnišnicah pogosta praksa, zlasti ko gre za zdravila z visokim tveganjem.

Tabela 1: Vloga kliničnega farmacevta in njegova prisotnost na oddelkih

Izkušnje anketiranih glede prisotnosti/neprisotnosti kliničnega farmacevta na oddelkih	Prisotnost kliničnega farmacevta na oddelku (N = 38)		Ni prisotnosti kliničnega farmacevta na oddelku (N = 95)		Hi-kvadrat preizkus	
	N (število)	% (odstotek)	N (število)	% (odstotek)	χ^2	p
Moteč dejavnik, ker me stalno nadzoruje pri pripravi in delitvi terapije.	3	7,9	8	8,4	0,010	0,921
Dobrodošel dejavnik, ker s svojimi nasveti in priporočili skrbi tako za varnost osebja kot tudi pacientov (kar se tiče področja rokovanja z zdravili).	27	71,1	46	48,4	5,615	0,018
Vzpodbuda za delo ter varno in kakovostno oskrbo pacientov.	10	26,3	21	22,1	0,269	0,604
Nimam izkušenj.	9	23,7	50	52,6	9,215	0,002

(Vir: Lasten vir 2024.)

Sodelovanje kliničnega farmacevta na vizitah na oddelkih, ki so sodelovali v dotični raziskavi, je še vedno zelo redko. Visok delež sodelujočih, 71,4%, trdi, da klinični farmacevt ni prisoten pri vizitah na oddelku. Zanimivi pa so tudi podatki o stališčih zaposlenih v SBMS glede prisotnosti

kliničnih farmacevtov na oddelku. Ker je izkušenj s tega področja malo, tudi rezultati nimajo nekega signifikantnega značaja. Vzpodbudno je, da prisotnost kliničnega farmacevta označujejo kot dobrodošel dejavnik, ker da s svojimi nasveti skrbi za varno in kakovostno opravljeno delo. Zgoraj navedeno lahko povežemo s H3, ki jo ovržemo, saj so rezultati v tabeli 1 pokazali, da prisotnost kliničnega farmacevta na oddelku ne moti delovnega procesa in da pripomore k varnejši oskrbi pacientov na oddelku. Hi-kvadrat preizkus je pokazal, da se s tem rezultatom nadpovprečno strinjajo tisti, ki imajo s prisotnostjo kliničnega farmacevta že izkušnje. Tudi kar se tiče prisotnosti/neprisotnosti kliničnega farmacevta na oddelku večina anketiranih – tako tisti, ki imajo izkušnjo s kliničnim farmacevtom in tisti, ki je nimajo – to obliko dela označujejo za pozitivno.

Tabela 2: Vpliv strahu pred izgubo službe in obsojanje sodelavcev na nepriznavanje napak povezanih z rokovanjem z zdravili

Dejavniki, ki vplivajo na nepriznavanje napak pri rokovanju z zdravili (N = 133)	N (število)	% (odstotek)
Strah pred obsojanjem sodelavcev	113	85,0
Strah pred nezaupanjem sodelavcev	80	60,2
Strah pred psihičnem nasiljem s strani vodje oddelka	50	37,6
Strah pred izgubo službe	71	53,4
Strah pred obtožbo (kazenska/zaporna kazen)	70	52,6
Odvzem delovne licence	54	40,6
Drugo: ni opredelitve	8	6,0

(Vir: Lasten vir 2024.)

Pri H4 se je ugotavljalo, v kolikšni meri strah pred izgubo službe ali obsojanje sodelavcev vplivata na nepriznavanje napak pri rokovanju z zdravili. Iz tabele 2 je razvidno, da ta dva dejavnika v več kot 50% potrjujeta trditev, zato torej H4 potrdimo.

Celotnega zdravstvenega sistema ni mogoče spremeniti, lahko pa s svojimi pozitivnimi dejanji in zgledi vplivamo na posameznikovo ravnanje v primeru skorajšnje napake ali napake, ki se je dejansko zgodila. Pomembno je zavedanje nas, zaposlenih v zdravstvu, da smo tudi mi del tega sistema, in sicer ne le kot izvajalci, ampak tudi kot uporabniki.

4 RAZPRAVA

Cilj raziskave je bil predstaviti najpogostejše dejavnike, ki vplivajo na napake pri rokovanju z zdravili. Prav tako je bil cilj preveriti uporabo strategij za zmanjšanje napak, povezanih z rokovanjem z zdravili v SBMS ter oceniti odnos zdravstvenih delavcev do sporočanja napak v zvezi z obravnavano tematiko. V raziskovalnem delu smo ugotovili, da sodelujoči v raziskavi menijo, da je (s povprečno vrednostjo 2,10) najbolj moteč dejavnik, zaradi katerega prihaja do tovrstnih napak, nečitljiv zapis terapije na terapevtskem listu. Temu sledi še preobremenjenost medicinskih sester (graf 1). Študija v Turčiji, v kateri so ugotavljali, ali medicinske sestre dojemajo vzroke za napake pri rokovanju z zdravili ter stopnjo samega poročanja o teh napakah, je pokazala, da medicinske sestre izpostavljajo, da do napak prihaja zaradi premajhnega števila osebja, velikih delovnih obremenitev ter nečitljivih zapisov naročil s strani zdravnikov (Biskin Cetin in Cebeci 2021). Prav tako se je pri H1 primerjal statistično značilni vpliv nemirnega in hrupnega okolja ter nezbranosti pri delu na nastanek napak pri rokovanju z zdravili. Ugotovljeno je bilo, da imata ta dva moteča dejavnika pomemben vpliv na pojavnost napak pri rokovanju z zdravili, kar je prav tako razvidno iz grafa 1. Podobne vzroke za nastanek napak so omenjali tudi v teheranski študiji, kjer so medicinske sestre izpostavile naslednje vzroke oz. dejavnike, ki vplivajo na napake pri rokovanju z zdravili: nečitljiv zapis terapije na terapevtskem listu, preobremenjenost medicinskih sester, uporaba podobnih/zvočno podobnih zdravil, pomanjkanje farmakološkega znanja in odsotnost kliničnega farmacevta na oddelku (Izadpanah idr. 2018). S H1 smo obenem pridobili odgovor na prvo raziskovalno vprašanje.

Glede na H2, s katero smo ugotavljali vpliv preobremenjenosti medicinskih sester in neizkušenost le teh na pojavnost napak pri rokovanju z zdravili, v obeh primerjanih starostnih skupinah (nad 40 let in pod 40 let) ni statistično značilnih razlik, kar lahko vidimo tudi v grafu 2. V opazovalni študiji, ki so jo izvedli v pediatrični bolnišnici v Sydneyju v Avstraliji, so preučevali dejavnike, ki lahko vplivajo na napake pri rokovanju z zdravili. Opazovali so značilnosti medicinske sestre (delovne izkušnje, spol, starost), delovne spremenljivke (npr. čas aplikacije zdravila, dan v tednu, prisotnost starša/skrbnika) ter vrsto zdravila (uporaba topila, pot, zdravila z visokim tveganjem). Ugotovili so, da nobena značilnost medicinske sestre ni bila povezana z napako pri rokovanju z zdravili (Westbrook idr. 2024). Podobno raziskavo so izvedli tudi v Teheranu in niso našli statistično značilnih povezav med številom napak in zgoraj omenjenimi dejavniki (Izadepah idr. 2018).

Drugo raziskovalno vprašanje se nanaša na področje strategij, ki obravnavajo področja varnega rokovanja z zdravili. Ugotoviti smo želeli, katere strategije se že uporabljajo v Splošni bolnišnici Murska Sobota. Med te strategije med drugim spadajo: upoštevanje pravil 10P, ločeni prostori za rokovanje z zdravili, uporaba zaščitnih sredstev, dvojno preverjanje zdravil, sodelovanje kliničnega farmacevta na oddelku, sporočanje napak povezanih z rokovanjem z zdravili v sistem za poročanje neželenih dogodkov. Visok odstotek sodelujočih v raziskavi je potrdilo, da pri izvajanju teh nalog vedno upošteva pravilo 10P, kar 55,6%. V študiji, ki jo je izvedel Tsegaye idr. (2020), je bilo ugotovljeno, da so medicinske sestre slabo upoštevale pravila za dajanje zdravil. Od 109 opazovanih primerov, ko so medicinskih sestre pripravljale zdravilo, je le 11% takih, kjer so bila ta pravila izrecno upoštevana. Sodelujoči v naši raziskavi, prav tako v visokem deležu, 48,1%, pravijo, da imajo zagotovljene prostore za ustrezno rokovanje z zdravili. Huckels-Baumgart idr. (2021) so v svoji prospektivni študiji v Švici ugotavljali pomen ločenih prostorov za pripravo zdravil. Ugotovili so, da so se po uvedbi tega ločenega prostora v prvi vrsti zmanjšale že prekinitve med samo pripravo zdravil (iz 51,8 na 30 prekinitev na uro), čas priprave zdravila se je pomembno zvečal (iz 1,4 na 2,5 minute), kar pa je najpomembneje, povprečna stopnja napak na dnevni bazi se je zmanjšala iz 1,3 na 0,9 napake na dan. Glede uporabe dvojnega preverjanja zdravil, so rezultati v izvedeni raziskavi razmeroma podobni. 51,1% sodelujočih pravi, da dvojno preverjanje uporabljajo, 48,9% pa to dejanje zanikajo. Iz rezultatov lahko sklepamo, da med uporabniki še ni natančnih opredelitev glede dvojnega preverjanja zdravil. Dvojno preverjanje zdravil je v bolnišnicah pogosta praksa, zlasti ko gre za zdravila z visokim tveganjem. V študiji, ki je proučevala učinke dvojnega preverjanja zdravil z namenom zmanjšanja stopnje napak, ki se lahko pojavijo pri rokovanju z zdravili, so prišli do nejasnih spoznanj glede učinkovitosti le-tega. Ni dovolj dokazov, da bi bilo dvojno preverjanje učinkovitejše od enkratnega preverjanja (Koyama idr. 2020).

Sodelovanje kliničnega farmacevtah na vizitah na oddelkih, ki so sodelovali v dotični raziskavi, je še vedno zelo redko. Visok delež sodelujočih, 71,4%, trdi, da klinični farmacevt ni prisoten pri vizitah na oddelku. Štuhec (2018) v svojem članku opisuje zakon o lekarniški dejavnosti (ZLD-1), ki poudarja pomen in naloge kliničnega farmacevta ter njegovo nujno prisotnost v procesu zdravstvene oskrbe pacientov. Naloga kliničnega farmacevta je, da dnevno predlaga spremembe v zvezi z zdravljenjem z zdravili ter na ta način tudi prispeva k boljšim ekonomskim in kliničnim izidom. Ker je izkušenj s tega področja malo, tudi rezultati nimajo nekega signifikantnega značaja. Vzpodbudno pa je, da prisotnost kliničnega farmacevta označujejo kot dobrodošel dejavnik, ker s svojimi nasveti skrbi za varno in kakovostno opravljeno delo. Zgoraj navedeno lahko povežemo s H3, ki jo ovržemo, saj so rezultati v tabeli 1 pokazali, da prisotnost kliničnega farmacevta na oddelku ne moti delovnega procesa in da pripomore k varnejši oskrbi pacientov na oddelku. Hi-kvadrat preizkus je pokazal, da se s tem rezultatom nadpovprečno strinjajo tisti, ki imajo s prisotnostjo kliničnega farmacevta že izkušnje. Tudi glede na prisotnost/neprisotnost kliničnega farmacevta na oddelku večina anketiranih, tako tisti, ki imajo izkušnjo s kliničnim farmacevtom in tisti, ki je nimajo, to obliko dela označujejo za pozitivno.

Za varnost drug drugega moramo odgovarjati. Vsi moramo razumeti, da se je »motiti človeško«. Ko znamo to sprejeti, se lahko ustvari kultura varnosti v celotnem zdravstvenem sistemu (Palatnik 2016). Pomemben podatek je tudi ta, da so zaposleni v SBMS seznanjeni s sistemom za sporočanje napak (83,5%), ki med drugim omogoča tudi beleženje oz. prijavo napak, ki se lahko zgodijo pri rokovanju z zdravili. V Slovenji si medicinske sestre želijo, da se vzpostavi nekaznovalno okolje, da bi bili timski sestanki iskreni in z manj obsojanj ter pritiskov na posameznike; da bi bilo več strpnosti. Cilj je vzpostaviti kulturo varnosti (Vrbnjak 2017). Sodelujoči se tudi v kar 60,9% popolnoma strinjajo oziroma strinjajo, da je neobsojajoče ravnanje izjemnega pomena, predvsem v primeru, ko se zgodi nenamerna napaka.

Pri H4 se je ugotavljalo, v kolikšni meri vplivata strah pred izgubo službe ali obsojanje sodelavcev na nepriznavanje napak pri rokovanju z zdravili. Iz tabele 2 je razvidno, da ta dva dejavnika v več kot 50% potrjujeta trditev, zato torej H4 potrdimo. Presečna študija, ki je bila izvedena v Savdski Arabiji, poroča o ovirah o poročanju napak pri rokovanju z zdravili. Kot največje ovire za poročanje so medicinske sestre izpostavile strah pred obtožbami in strah pred disciplinskimi ukrepi. Kar v 65,4% so izpostavile strah pred obtoževanjem (Alrasheeday idr. 2024). Podobno študijo so izvedli v Egiptu, kjer so kot največjo oviro za poročanje napak izpostavili strah pred nastalimi posledicami (Fathallah idr. 2023).

Ko se pogovarjamo o napakah v zdravstvu, se moramo zavedati, da se nekaterim napakam lahko tudi izognemo, vendar tak način dela terja veliko več napora in truda. Celotnega zdravstvenega sistema ni mogoče spremeniti, lahko pa s svojimi pozitivnimi dejanji in zgledi vplivamo na posameznikovo ravnanje v primeru skorajšnje napake ali napake, ki se je dejansko zgodila.

Kot omejitve pri sami raziskavi lahko omenimo to, da je to področje v slovenskem prostoru slabše raziskano ter je na voljo manj strokovne literature s tega področja. Zaposleni si želijo več znanj iz obravnavanega področja, želijo pa si tudi, da v njihovi delovni organizaciji prav tako zaživi varna in kakovostna kultura dela (neobsojajoče delovno okolje). Če na kratko povzamemo rezultate raziskave, vidimo, da zaposleni prepoznajo dejavnike, ki vplivajo na napake pri rokovanju z zdravili ter jih tudi kritično označijo. Ker je zaposlen večinoma mlad kader, je nagnjenost k digitalizaciji v zdravstvu višja. Zaposleni se zavedajo odgovornosti, ki jih prinašajo intervencije v zdravstvu, hkrati pa jih skrbi za ugled v delovnem timu in za lastno socialno varnost. Področje zdravil, sploh če se ta uporablja nepravilno, lahko prinaša zelo neugodne posledice na zdravje pacienta. Obenem pa je področje rokovanja z zdravili zelo pomembno tudi za nas kot zdravstvene delavce. Gre za področje, ki ga je potrebno čim bolj dodelati z jasnimi navodili in smernicami. Potrebno je vzpodbujati tak način dela, ki bo vzpodbudil zaupanje med sodelavci. Vsakodnevno vključevanje refleksije glede opravljenega dela (predvsem težkih situacij), s katerimi se vsakodnevno srečujejo zaposleni v zdravstvu, lahko pripomore k iskanju načinov, kako bi lahko še uspešneje pristopili h kakovostnejšemu in varnejšemu rokovanju z zdravili. Uvedba neobsojajoče delovne klime bi vsekakor izboljšala odnos do sporočanja napak, s katerimi se srečujemo v zdravstvu. Ta način dela bi zaposlene vzpodbudil k iskanju rešitev, učinkovitejši implementaciji novih smernic v svojo prakso ter navsezadnje tudi hitrejšo prepoznavanje morebitnih napak, ki bi lahko nastale v delovnem procesu.

5 ZAKLJUČEK

S sistematičnim strateškim pristopom ter uvajanjem inovativnejših usmeritev s strani farmacevtov ter podpore vodstva se lahko ustvari kakovostnejše in predvsem varnejše okolje za paciente in tamkajšnje zaposlene.

V naši raziskavi smo ugotovili, da nečitljiv zapis terapije na terapevtskem listu predstavlja dejavnik z visokim tveganjem za nastop napak, ki se lahko pojavijo pri rokovanju z zdravili. Zaradi tega smo izpostavili tudi pomen digitalizacije v zdravstvenem sistemu. Elektronski temperaturni list prinaša izziv za vse zaposlene v zdravstvu, tako za vodstva bolnišnic kot tudi za ostale zaposlene, saj prinaša dodatne kadrovske, finančne obremenitve, obenem pa potrebo po dodatnem izobraževanju zaposlenih. Smiselno bi bilo tudi izvesti opazovalno študijo, v kateri bi raziskali, katere so tiste dejanske in najpogostejše napake, ki se pojavljajo v praksi. Na ta način bi ugotovili, ali zdravstveni delavci upoštevajo vsa do sedaj uporabljena priporočila za varno ravnanje z zdravili. Mnoge študije omenjajo latentne napake, torej tiste napake, ki tičijo nekje globoko v zdravstvenih sistemih, vendar se s temi nekako ne znamo spoprijeti. Rezultati raziskav, podprtih z dokazi, bi morali biti predstavljeni »bolj glasno, bolj poudarjeno«. Veliko spoznanj je prinesla že kampanja, s katero se opozarja na zmanjšanje škode v povezavi z zdravili za 50% v petih letih, ki jo je izvedla Svetovna zdravstvena organizacija. Tudi uvedba zakona, ki bi zahteval zaposlitev več kliničnih farmacevtov po zdravstvenih organizacijah ter njihovo vključevanje v multidisciplinarne time, je in bo z zagotovostjo pripeljala do boljših rezultatov na področju uporabe in rokovanja z zdravili. Z gotovostjo lahko trdimo, da bi bilo na nivoju bolnišnice smiselno ustvariti delovno skupino, ki bi sodelovala s sodelavci, ki delujejo na področju kakovosti in se ukvarjajo tudi z raziskovalno dejavnostjo, ter izoblikovati smernice, po katerih bi se ravnali vsi zaposleni. Sistemi glede poročanja neželenih dogodkov so dostopni in znani večini zaposlenih, vendar je potrebno vlagati dodatne napore za doseganje zmanjšanja strahu med zaposlenimi glede poročanja napak ter ustvarjanja kakovostne, ugodne ter neobsojajoče delovne klime.

Potrebna je tudi samokritičnost v smislu, da v mislih preletimo »kritične« dogodke, s katerimi smo se srečali pri opravljanju svojega dela. Na to lahko opozorimo svoje sodelavce in po potrebi tudi predelamo dotične dogodke. Že če bi vsakdo izmed nas, ki delujemo v zdravstvenem sistemu, prispeval le delček svojih zamisli za ustvarjanje boljšega jutri za paciente in navsezadnje tudi za nas, ki smo prav tako uporabniki zdravstvenih storitev, ter prispeval majhen delež svojega znanja v kakovostno in varno obravnavo, bi zagotovo utrdili marsikatero še neutrjeno pot v zdravstvenem sistemu.

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