EFEKTI KONTROLISANOG FIZIČKOG TRENINGA KOD BOLESNIKA SA SRČANOM INSUFICIJENCIJOM

STRUČNI ČLANCI

PROFESSIONAL ARTICLES

EFFECTS OF CONTROLLED PHYSICAL TRAINING IN PATIENTS WITH HEART FAILURE

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SAŽETAK

Srčana insuficijencija (engl. heart failure – HF) je klinički sindrom koji se sastoji od kardijalnih simptoma (npr. nedostatak vazduha, otok potkolenica i umor), koje mogu pratiti znaci (npr. povišen jugularni venski pritisak, pukoti nad plućima i periferni edemi). Bolesnici sa HF imaju česte hospitalizacije, narušen im je kvalitet života i skraćen životni vek. Bolesnici sa HF imaju smanjen fizički radni kapacitet, koji je u velikoj meri izazvan narušenom hemodinamikom protoka krvi u aktivnoj skeletnoj muskulaturi. Bolesnicima sa HF potrebno je uraditi kardiopulmonalni test fizičkim opterećenjem, radi procene nivoa i vrsta fizičke aktivnosti koji će se nakon toga sprovoditi i neophodno je izvršiti stratifikaciju rizika. Treba početi procenom trenutnih mogućnosti i potreba pacijenta za vežbanjem i sastaviti početni program vežbanja sa određenom vrstom vežbi, njihovim intenzitetom, brojem ponavljanja i trajanjem u minutima tokom jednog dana, kao i brojem dana u kojima treba vežbati tokom nedelje. Preporučuje se vožnja bicikle (statičke ili obične) i pešačenje, što predstavlja aerobni, dinamički tip vežbanja. Aerobni tip treninga se preporučuje 3–5 puta nedeljno (30–60 minuta po treningu), a prioritet ima intervalni tip treninga. Ovaj vid treninga poboljšava snagu i izdržljivost skeletnih mišića i dovodi do povećanja mišićne mase. Kod bolesnika sa srčanom insuficijencijom i kaheksijom preporučuje se rezistentni tip treninga, koji je kombinacija izotoničkog i izometrijskog opterećenja. Ovu vrstu treninga treba sprovoditi dva puta nedeljno u trajanju 12–20 minuta. Ovaj vid treninga poboljšava snagu i izdržljivost skeletnih mišića i dovodi do povećanja mišićne mase. Fizički trening povećava mišićnu masu skeletnih mišića, promer mišićnog vlakna, snagu, izdržljivost i fizički radni kapacitet.

Ključne reči: srčana slabost, aerobni trening, fizičke vežbe, fizički radni kapacitet

ABSTRACT

Heart failure (HF) is a clinical syndrome characterized by cardiac symptoms (e.g.,breathlessness, ankle swelling, and fatigue), which may be accompanied by signs (e.g., elevated jugular venous pressure, pulmonary crackles, and peripheral edema). Patients with HF often experience frequent hospitalizations, impaired quality of life, and shortened life expectancy. They also have decreased exercise capacity, primarily due to impaired hemodynamics within the active skeletal muscles. Patients with HF should undergo a cardiopulmonary exercise test to assess their activity level and type, as well as to perform risk stratification. The initial step should include evaluating the patient's current exercise capacity and needs, then creating a personalized exercise program that details the types of exercises, their intensity, repetitions, duration in minutes per session, and the number of days per week allocated for training. Cycling (either on a stationary or regular bicycle) and walking are recommended because they are aerobic, dynamic forms of exercise. Aerobic training should be performed 3–5 times a week (30–60 minutes per session), with emphasis on interval training. This type of training enhances skeletal muscle strength and endurance, leading to increased muscle mass. In patients with heart failure and cachexia, resistance training is advised, combining both isotonic and isometric exercises. This type of training should be performed twice a week for 12 to 20 minutes per session. Resistance training also enhances skeletal muscle strength and endurance and encourages muscle growth. Physical training enhances skeletal muscle mass, fiber diameter, strength, endurance, and exercise capacity.

Keywords: heart failure, aerobic training, physical exercises, physical work capacity

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UVOD

Srčana insuficijencija (engl. *heart failure* – HF) je klinički sindrom koji se sastoji od kardijalnih simptoma (npr. nedostatak vazduha, otok potkolenica i umor) koje mogu pratiti znaci (npr. povišen jugularni venski pritisak, pukoti nad plućima i periferni edemi). HF nastaje usled strukturne i/ili funkcionalne abnormalnosti srca koje rezultira povećanim intrakardijalnim pritiscima i/ili neadekvatnim srčanim minutnim volumenom srca u miru i/ili naporu. Identifikacija etiologije srčane disfunkcije je obavezna u dijagnostici HF radi odluke o daljem lečenju. Najčešće, HF nastaje usled miokardne disfunkcije: sistolne, dijastolne ili obe [1].

HF ostaje vodeći globalni uzrok smrtnosti, morbiditeta i lošeg kvaliteta života uz visoku upotrebu resursa i troškove zdravstvene zaštite. Iako je incidencija HF vremenom blago opala, njena prevalenca raste zbog poboljšanih tretmana HF i dužeg životnog veka u populaciji [2]. U evropskim zemljama, srednja incidenca HF je 3,20 slučajeva na 1000 osoba, a srednja prevalenca HF je 17,20 slučajeva na 1000 ljudi [1,3].

Iako ishemijska bolest srca ostaje jedan od najčešćih uzroka HF, poboljšanja u lečenju akutnog infarkta miokarda (AIM) i sekundarne prevencije smanjili su rizik od HF hospitalizacije nakon prvog AIM-a. Prevalenca srčane insuficijencije se povećava sa godinama starosti, a najčešći uzrok u bolesnika mlađih od 75 godina je koronarna bolest [1,4–6].

Pacijenti osim HF, često imaju i nekoliko drugih bolesti. Komorbiditeti se grubo dele na kardiovaskularne i nekardiovaskularne bolesti. Od kardiovaskularnih komorbiditeta najčešći su arterijska hipertenzija, koronarna bolest i atrijalna fibrilacija [7,8]. Od nekardiovaskularnih komorbiditeta najčešći su dijabetes melitus, bubrežna insuficijencija, hronična opstruktivna bolest pluća i anemija [9,10].

Prema vrednostima ejekcione frakcije leve komore (engl. *left ventricular ejection fraction* – LVEF) srčana slabost se deli na onu sa očuvanom, blago redukovanom i redukovanom ejekcionom frakcijom leve komore. Redukovana LVEF je definisana kao ≤ 40%, npr. kod onih za značajnom redukcijom sistolne funkcije leve komore i ovo se označava kao (engl. *heart failure with reduced ejection fraction* – HFrEF). Pacijenti sa LVEF opsega 41% do 49% imaju blago redukovanu sistolnu funkciju leve komore, tj. „srčana insuficijencija blago redukovane ejekcione frakcije" (engl. *heart failure with mildly reduced ejection fraction* – HFmrEF). HF sa očuvanom ejekcionom frakcijom (engl. *heart failure with preserved ejection fraction* – HFpEF) podrazumeva LVEF ≥ 50%. Za postavljanje dijagnoze srčane insuficijencije sa očuvanom ili umereno smanjenom LVEF osim prisustva simptoma i znaka potrebno je prisustvo povećane vrednosti natri-

INTRODUCTION

Heart failure (HF) is a clinical syndrome characterized by cardiac symptoms (e.g., shortness of breath, leg swelling, and fatigue), which may be accompanied by signs (e.g., elevated jugular venous pressure, pulmonary crackles, and peripheral edema). HF occurs due to structural and/or functional abnormalities of the heart, leading to increased intracardiac pressures and/or inadequate cardiac output at rest and during exertion. Identifying the etiology of cardiac dysfunction is essential for diagnosing HF and guiding further treatment. Most often, HF results from myocardial dysfunction, which can be systolic, diastolic, or both [1].

HF remains a leading global cause of mortality, morbidity, and poor quality of life, with high resource utilization and healthcare costs. Although the incidence of HF has slightly decreased over time, its prevalence continues to increase due to improved HF treatments and increased life expectancy in the general population [2]. In European countries, the median incidence of HF is 3.20 cases per 1000 people, while the median prevalence is 17.20 cases per 1000 individuals [1,3].

Although ischemic heart disease remains one of the most common causes of HF, advances in treating acute myocardial infarction (AMI) and secondary prevention have lowered the risk of HF hospitalization after a first AMI. The prevalence of heart failure increases with age, and among patients under 75 years old, the most common cause is coronary artery disease [1,4–6].

Patients with HF often have multiple other comorbidities. Comorbidities are generally classified into cardiovascular and non-cardiovascular conditions. Among cardiovascular comorbidities, the most common are arterial hypertension, coronary artery disease, and atrial fibrillation [7,8]. For non-cardiovascular comorbidities, the most frequent include diabetes mellitus, renal insufficiency, chronic obstructive pulmonary disease, and anemia [9,10].

According to left ventricular ejection fraction (LVEF), heart failure is classified into preserved, mildly reduced, and reduced ejection fraction. Reduced LVEF is defined as ≤40%, indicating a significant decrease in left ventricular systolic function, known as heart failure with reduced ejection fraction (HFrEF). Patients with LVEF between 41% and 49% have mildly reduced systolic function, called heart failure with mildly reduced ejection fraction (HFmrEF). Heart failure with preserved ejection fraction (HFpEF) refers to an LVEF of 50% or higher. To diagnose HF with preserved or mildly reduced LVEF, symptoms and signs must be present along with elevated natriuretic peptide levels and at least one of the following: relevant structural heart disease (such as left ventricular hypertrophy or left atrial

uretskog peptida uz prisustvo minimum još jednog od sledećih kriterijuma: relevantno strukturno oštećenje srca (hipertrofija leve komore ili uvećana leva pretkomora) i/ili dijastolna disfunkcija leve komore [1,11–13].

Srčana insuficijencija može biti i rezultat disfunkcije desne komore. Mehanika i funkcija desne komore su izmenjene u sklopu opterećenjem pritiskom, ili volumenom. Osnovna etiologija hronične srčane slabosti desne komore je plućna hipertenzija nastala usled disfunkcije leve komore, ali postoje brojni drugi uzroci [1,14].

U kliničkoj praksi, za težinu srčane insuficijencije najčešće su korišćene klasifikacije Njujorškog kardiološkog društva (NYHA klasifikacija) i klasifikacija Američkog Udruženja kardiologa (ACC/AHA) [1].

NYHA funkcionalna klasifikacija zasnovana je na težini simptoma i fizičkoj aktivnosti:

- Klasa I: Bolesnik nema ograničenja fizičke aktivnosti, uobičajeno fizičko opterećenje ne dovodi do zamora, gušenja ili palpitacija.
- Klasa II: Postoji manje ograničenje fizičke aktivnosti, bolesnik se oseća dobro kada miruje ali uobičajene aktivnosti izazivaju zamor, gušenje ili palpitacije.
- Klasa III: Bolesnik ima značajno ograničenje fizičke aktivnosti, oseća se dobro u mirovanju, ali male uobičajene aktivnosti dovode do simptoma.
- Klasa IV: Pri najmanjoj fizičkoj aktivnosti javljaju se tegobe ili su simptomi SI prisutni u mirovanju a pogoršavaju se pri najmanjem fizičkom naporu.

ACC/AHA klasifikacija težine srčane insuficijencije:

- Stadijum A: Veliki rizik za razvoj srčane insuficijencije ali bez prisustva strukturnog oboljenja srca ili simptoma srčane insuficijencije.
- Stadijum B: Prisustvo strukturnog oboljenja srca bez simptoma i znakova srčane insuficijencije.
- Stadijum C: Prisustvo strukturnog oboljenja srca sa simptomima srčane insuficijencije.
- Stadijum D: Refrakterna srčane insuficijencije koja zahteva primenu specijalnih intervencija.

HEMODINAMSKE PROMENE U SRČANOJ INSUFICIJENCIJI

Kod bolesnika sa HF smanjen je fizički radni kapacitet. Ovo smanjenje u velikoj meri izazvano je hemodinamikom protoka krvi u aktivnoj skeletnoj muskulaturi (sekundarno usled smanjenja minutnog volumena srca), tako da ovi bolesnici mogu postići manji maksimalni minutni volumen u odnosu na zdrave osobe. Neadekvatna hemodinamika protoka krvi u aktivnoj skeletnoj muskulaturi nastaje i usled disfunkcije endotela, tako da se pri fizičkom naporu krvni sudovi neadekvatno prošire. Udarni volumen u miru, koji je značajno smanjen u sistolnoj HF, slabo se povećava tokom vežbanja zbog smanjene sposobnost da se poveća

enlargement) and/or left ventricular diastolic dysfunction [1,11–13].

Heart failure can also result from right ventricular dysfunction. Right ventricular mechanics and function may be affected by pressure or volume overload. The primary cause of chronic right ventricular failure is pulmonary hypertension due to left ventricular dysfunction, although many other causes exist [1,14].

In clinical practice, the severity of HF is usually assessed using the New York Heart Association (NYHA) classification and the American College of Cardiology/American Heart Association (ACC/AHA) classification [1].

The NYHA functional classification is based on symptom severity and physical activity:

- Class I: No restrictions on physical activity; regular physical activity does not lead to fatigue, dyspnea, or palpitations.
- Class II: Slight restriction in physical activity; comfortable at rest, but normal activity causes fatigue, dyspnea, or palpitations.
- Class III: Significant restriction of physical activity; comfortable at rest, but less-than-normal activity causes symptoms.
- Class IV: Symptoms of heart failure are present at rest; any physical activity leads to increased discomfort.

ACC/AHA Classification of Heart Failure Severity:

- Stage A: High risk of developing heart failure but without structural heart disease or heart failure symptoms.
- Stage B: Structural heart disease present but without signs or symptoms of HF.
- Stage C: Structural heart disease presenting with symptoms of heart failure.
- Stage D: Refractory heart failure requiring specialized interventions.

HEMODYNAMIC CHANGES IN HEART FAILURE

In patients with HF, physical exercise capacity is limited. This limitation mainly results from hemodynamic changes in active skeletal muscle (secondary to reduced cardiac output), so these patients can achieve a lower maximal cardiac output than healthy individuals. Inadequate blood flow hemodynamics in active skeletal muscle also stem from endothelial dysfunction, leading to insufficient vasodilation during physical activity. Stroke volume at rest, which is significantly reduced in systolic HF, increases only slightly during exercise due to impaired ability to enhance left ventricular preload and LVEF [15]. The reduced capacity to increase left ventricular end-diastolic volume results from the dilated left ventricle already operating near its maximum volume, exhausting its preload reserve [4,16].

prethodno opterećenje (*preload*) leve komore i LVEF [15]. Smanjena sposobnost da se poveća enddijastolni volumen leve komore objašnjava se činjenicom da dilatirana leva komora radi sa već maksimalnim volumenom, tako da su iscrpljene njene rezervne mogućnosti za povećanje *preloada* [4,16].

Kod bolesnika sa HF, vršna potrošnja kiseonika (*peak* VO2) i VO2 na ventilatornom anaerobnom pragu su tipično redukovani u odnosu na zdrave osobe, proporcionalno težini simptoma srčane insuficijencije. Ventilatorni anaerobni prag se temelji na konceptu da pri određenom radu snabdevanje mišića kiseonikom ne ispunjava njegove zahteve, a ova neravnoteža povećava zavisnost od anaerobne glikolize za proizvodnju energije, sa laktatima kao konačnim metaboličkim proizvodom. Mlečna kiselina se tada puferuje bikarbonatima, oslobađa se višak CO2. Rezultat porasta nivoa CO2 jeste povećanje ventilacije zbog aktivacije hemoreceptora u karotidnim sinusima sa ciljem eliminisanja viška CO2.

Kada je izražen u odnosu na izmereni *peak* VO2, ventilatorni anaerobni prag se javlja na približno 40%–60% od *peak* VO2 u većini srčanih bolesnika, s trendom prema većem procentu od *peak* VO2 u bolesnika s hroničnom srčanom insuficijencijom [16].

FIZIČKI TRENING / VEŽBANJE – OPŠTA RAZMATRANJA

Termin „vežbanje" se definiše kao „aktivnost koja zahteva fizički napor i koja se sprovodi radi održavanja ili poboljšanja zdravlja i pripremljenosti" ili kao „telesni napor radi razvoja i održavanja fizičke pripremljenosti". Postoji čitav niz sličnih definicija, a u svima je uočljivo da je vežba opisana kao aktivan proces, tokom kojeg pojedinac svesno preduzima dodatne napore (u odnosu na stanje mirovanja) koji uključuju određeni stepen fizičkog opterećenja. Kada bi proučavali istoriju medicine uvideli bi da je vežbanje od samih početaka preporučivano za očuvanje zdravlja i kao oblik lečenja. Verovatno jedan od najčešće navođenih citata koji se pripisuje Hipokratu glasi:„Kada bismo svakom pojedincu dali pravu količinu ishrane i vežbanja, ne premalo i ne previše, pronašli bismo najsigurniji put do zdravlja". Međutim, tokom poslednje decenije koncept „Vežbanje je lek" postao je globalna zdravstvena inicijativa, s ciljem da procena fizičke aktivnosti i promocija vežbanja postane standard u kliničkoj praksi, povezujući zdravstvenu zaštitu sa fizičkom aktivnošću i vežbanjem zasnovanom na dokazima. Osnov za takav pristup je teza da fizička aktivnost i vežbanje promovišu optimalno zdravlje i da trebaju biti sastavni deo prevencije i lečenja mnogih zdravstvenih stanja. Ovakvim pristupom ohrabruju se lekari i drugi pružaoci zdravstvenih usluga da uključe vežbanje prilikom kreiranja planova lečenja

In patients with HF, peak oxygen consumption (peak VO2) and VO2 at the ventilatory anaerobic threshold are usually diminished compared to healthy individuals, in proportion to the severity of HF symptoms. The ventilatory anaerobic threshold is based on the idea that, at a certain workload, oxygen delivery to the muscles no longer meets their metabolic needs. This imbalance increases reliance on anaerobic glycolysis for energy production, with lactate as the end product. Lactic acid is then buffered by bicarbonate, releasing excess CO_2. The rise in CO_2 levels stimulates increased ventilation by activating chemoreceptors in the carotid sinuses, aiming to eliminate excess CO_2.

When expressed relative to measured peak VO_2, the ventilatory anaerobic threshold generally occurs at about 40%–60% of peak VO_2 in most cardiac patients, with a tendency toward a higher proportion of peak VO_2 in patients with chronic HF [16].

PHYSICAL TRAINING / EXERCISE – GENERAL CONSIDERATIONS

The term "exercise" is defined as "activity that requires physical effort and is performed to maintain or improve health and fitness" or as "physical exertion undertaken to develop and maintain physical fitness." Numerous similar definitions exist, all emphasizing that exercise is an active process during which an individual consciously exerts extra effort (compared with rest), involving a certain degree of physical load. A review of medical history shows that exercise has been recommended for health maintenance and therapeutic purposes since ancient times. One of the most frequently cited quotes attributed to Hippocrates states: "If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health." However, in the past decade, the concept "Exercise is Medicine" has become a global health initiative, aiming to make physical activity assessment and the promotion of exercise a standard part of clinical practice, connecting healthcare with evidence-based physical activity and exercise. This approach is based on the idea that physical activity and exercise promote optimal health and should be essential for preventing and treating many medical conditions. This strategy encourages physicians and other healthcare providers to include exercise in treatment plans and refer patients to evidence-based exercise programs and qualified exercise professionals. The role of exercise in preventing and managing chronic diseases is relatively well understood [17]. It is believed that, alongside exercise, proper dietary modification can

i da upućuju pacijente na programe vežbanja zasnovane na dokazima i kvalifikovane stručnjake za vežbanje. Značaj vežbanja u prevenciji i lečenju hroničnih bolesti su relativno dobro opisane [17]. Smatra se da uz vežbanje, jedino pravilna modifikacija ishrane, deluje na smanjenje rizika od skoro svih hroničnih bolesti istovremeno [18]. Sistematski pregledni članci i meta-analize pokazuju da je vežbanje slično delotvorno kao i lekovi za lečenje nekoliko hroničnih stanja, što pruža naučnu potporu konceptu „Vežbanje je lek" [19,20].

Pacijenti mogu dobiti sveobuhvatnu procenu i svojevrsni recept u vidu smernica i uputstava za vežbanje u kliničkom modulu. U skladu sa tim, vežbanje treba sprovoditi u modulu zajednice. Razvoj aktivne zdravstvene tehnologije omogućava pacijentima da efikasnije vežbaju. Razvoj opreme za vežbanje, omogućava ljudima da steknu dobro iskustvo vežbanja i u izvesnoj meri smanje verovatnoću povreda pri vežbanju. Najnoviji napredak u tehnologiji, uključujući rehabilitacionu robotiku, uređaje za nošenje, virtuelnu stvarnost, veštačku inteligenciju i pametnu telemedicinu, pružaju pacijentima povratne informacije u realnom vremenu i kontinuirano im pomažu da ispune planirane ciljeve tokom vežbanja [21].

Individualizacija znači da treba izabrati intenzitet i vreme vežbanja u skladu sa ličnim mogućnostima. Ne preporučuje se potpuno praćenje iskustava drugih ljudi sa vežbanjem. Postepenost znači da intenzitet i vreme vežbanja treba povećavati korak po korak. Iznenadni visoki intenzitet i produženo vežbanje mogu naneti štetu, a ne potencirati zdravstvene koristi. Princip upornosti se odnosi na to da pacijent treba da shvati vežbu kao deo života i da razvija redovne navike za vežbanje. Nepridržavanje ovih principa otežava postizanje očekivanih rezultata. Izbor vrste, intenziteta, trajanja i ponavljanja vežbanja je složen zadatak [22,23].

FIZIČKI TRENING KOD KARDIOVASKULARNIH BOLESNIKA

Aktuelne smernice Svetske zdravstvene organizacije o fizičkoj aktivnosti i sedentarnom ponašanju naglašavaju da sve odrasle osobe treba da imaju 150–300 minuta fizičke aktivnosti umerenog intenziteta nedeljno [24]. Navedeno se može zameniti sa fizičkom aktivnosti visokog intenziteta ili nekom ekvivalentnom kombinacijom aerobne aktivnosti umerenog i visokog intenziteta u trajanju od 75–150 minuta nedeljno. Fizička neaktivnost ima velike efekte na globalno zdravlje i važan je faktor rizika za kardiovaskularne bolesti i ukupnu smrtnost, dok redovna fizička aktivnost ima suprotne efekte [25]. Jedna od studija sa najvećim obuhvatom ispitanika, ukupno njih 116.221, je pokazala da se faktori rizika za kardiovaskularne bolesti i ukupnu smrt-

also reduce the risk of nearly all chronic diseases [18]. Systematic reviews and meta-analyses show that exercise is as effective as pharmacological treatments for several chronic conditions, providing scientific support for the "Exercise is Medicine" concept [19,20].

Patients may receive a comprehensive assessment and a personalized exercise "prescription" in the clinical module. Based on this, exercise should be implemented within the community module. Advances in active health technology enable patients to exercise more effectively. Developments in exercise equipment allow individuals to gain a better exercise experience and reduce the likelihood of injuries. Recent progress in technology, including rehabilitation robotics, wearable devices, virtual reality, artificial intelligence, and innovative telemedicine, provides patients with real-time feedback and continuous support in meeting their exercise goals [21].

Individualization involves choosing the intensity and duration of exercise based on personal abilities. It is not advisable to completely follow other people's exercise routines. Progressiveness means gradually increasing the intensity and duration. Sudden high-intensity or long-duration exercise can cause harm rather than health benefits. The principle of persistence emphasizes that individuals should see exercise as part of daily life and develop consistent habits. Not following these principles decreases the chances of reaching desired results. Selecting the type, intensity, duration, and frequency of exercise is a complex task [22,23].

PHYSICAL TRAINING IN CARDIOVASCULAR PATIENTS

Current World Health Organization guidelines on physical activity and sedentary behavior stress that all adults should accumulate 150–300 minutes of moderate-intensity physical activity each week [24]. This can be replaced with high-intensity exercise or a combination of moderate- and high-intensity aerobic activities totaling 75–150 minutes weekly. Physical inactivity has serious consequences for global health and is a key risk factor for cardiovascular disease and all-cause mortality, while regular physical activity has the opposite effect [25]. One of the most extensive studies, involving 116,221 participants, showed that cardiovascular risk factors and all-cause mortality decrease by 19%–25% when the minimum weekly physical activity guidelines are followed, and by 15%–31% when both duration and high-intensity criteria are met [26].

Cardiovascular diseases are, at least in part, caused by poor or unhealthy diets and other lifestyle habits, which can be summarized as maladaptive dietary and lifestyle factors. A key aspect of lifestyle is physical ac-

nost smanjuju 19%–25% ukoliko se ispune smernice o minimalnoj fizičkoj aktivnosti na nedeljnom nivou, odnosno 15%–31% ukoliko se ispune kriterijumi trajanja aktivnosti i njen intenzitet bude visok [26]. Kardiovaskularna oboljenja su, barem delimično, posledica neodgovarajuće ili loše ishrane i drugih životnih navika, koje se mogu sažeti kao neprilagođeni faktori ishrane i načina života. Kritični sastavni element životnog stila su fizička aktivnost i vežbanje [27]. Dostizanje i održavanje preporučenih nivoa fizičke aktivnosti je u korelaciji sa smanjenim rizicima od infarkta miokarda i moždanog udara, kao i ukupne smrtnosti od kardiovaskularnih bolesti [28,29]. Vežbanje vrlo verovatno štiti od koronarne bolesti srca smanjenjem faktora rizika kao što su: povišen krvni pritisak, gojaznost, hiperlipidemija i insulinska rezistencija. Pored toga, vežbanje pruža pozitivne efekte na remodelovanje miokarda [5]. Vežbanje umerenog intenziteta koje se često praktikuje (prosečno 60–75minuta dnevno) smanjuje rizik od smrti povezan sa dugim periodima sedenja [30]. Viši intenziteti vežbanja i smanjenje vremena sedentarnih aktivnosti smanjuju sveukupni rizik smrtnosti [31]. Nalazi meta analiza pokazuju da postizanje preporučenih nivoa fizičke aktivnosti smanjuje rizik od nepovoljnih kardiovaskularnih događaja za 17%, smrtnost od kardiovaskularnih bolesti za 23%, a učestalost obolevanja od dijabetes melitusa tip 2 za 26% [32]. Ove rezultate su takođe potvrdili Kivimäki i saradnici [33] zaključujući da je odsustvo fizičke aktivnosti bilo povezano sa 24% većim rizikom od koronarne bolesti srca, 16% povećanim rizikom od moždanog udara i 42% većim rizikom od dijabetes melitusa tip 2.

Podaci iz skorašnje meta analize pokazuju 17% manji rizik od smrtnosti od kardiovaskularnih oboljenja ukoliko se ovakva vrsta aktivnosti upražnjava 40–60 minuta nedeljno [34]. Kombinacija fizičke aktivnosti umerenog ili visokog intenziteta daje najizraženije efekte na poboljšanje zdravlja kardiovaskularnog sistema i smanjenje rizika smrtnosti [35–37]. Sekundarna prevencija kardiovaskularnih oboljenja optimalno obuhvata individualno planirane programe vežbanja, zajedno sa promenama u načinu života (skraćenje sedentarnih aktivnosti, prestanak pušenja, planiranje ishrane) [38,39]. Studija koja je trajala pet godina pokazala je 32% manji rizik od smrtnosti kod pacijenata sa kardiovaskularnim oboljenjima (prethodni infarkt miokarda, kardiotorakalne operacije, angina pektoris) koji si učestvovali u programima rehabilitacije srca u poređenju sa onima koji nisu učestvovali [40]. Autori istraživanja koje je obuhvatilo 23.430 pacijenata sa kardiovaskularnim oboljenjima su zaključili da rehabilitacija srca zasnovana na vežbanju rezultira smanjenim rizikom od smrtnosti i poboljšanim kvalitetom života

tivity and exercise [27]. Achieving and maintaining the recommended levels of physical activity is associated with lower risks of myocardial infarction, stroke, and cardiovascular death [28,29]. Exercise likely protects against coronary heart disease by lowering risk factors such as hypertension, obesity, hyperlipidemia, and insulin resistance. Additionally, exercise has positive effects on myocardial remodeling [5]. Regular moderate-intensity exercise (about 60–75 minutes daily) reduces the risk of mortality linked to prolonged sitting [30]. Engaging in higher-intensity exercise and reducing sedentary time further decreases overall mortality risk [31]. Meta-analytic findings indicate that meeting recommended physical activity levels lowers the risk of adverse cardiovascular events by 17%, cardiovascular mortality by 23%, and the incidence of type 2 diabetes mellitus by 26% [32]. These findings were supported by Kivimäki et al. [33], who reported that physical inactivity was linked to a 24% higher risk of coronary heart disease, a 16% increased risk of stroke, and a 42% higher risk of type 2 diabetes mellitus. Recent meta-analytic data show a 17% lower risk of cardiovascular mortality when this type of activity is performed for 40–60 minutes weekly [34]. A combination of moderate- and high-intensity physical activity produces the most significant improvements in cardiovascular health and mortality reduction [35–37]. Secondary prevention of cardiovascular diseases ideally includes personalized exercise programs along with lifestyle changes (reducing sedentary behavior, quitting smoking, dietary planning) [38,39]. A five-year study showed a 32% reduction in mortality among patients with cardiovascular disease (previous myocardial infarction, cardiothoracic surgery, angina pectoris) who participated in cardiac rehabilitation programs compared to those who did not [40]. Authors of a study involving 23,430 cardiovascular patients concluded that exercise-based cardiac rehabilitation leads to decreased mortality and better quality of life [41].

Exercise should be regarded as an intervention that must be tailored and continuously adjusted to match the characteristics and preferences of the individuals it's prescribed for. Ideally, a maximal exercise test with direct measurement of maximal oxygen consumption (VO2 max) should be conducted for accurate risk assessment and to determine exercise zones before developing a program [42]. Exercise, especially high-intensity exercise, is contraindicated in certain situations, such as the first two days after acute coronary syndrome or in conditions like uncontrolled arrhythmia, active endocarditis, myocarditis, or pericarditis, severe symptomatic aortic stenosis, decompensated

[41]. Vežbanje treba shvatiti kao intervenciju koja treba da bude individualizovana i kontinuirano prilagođena karakteristikama i sklonostima osoba kojima je sa terapijskim ciljem namenjena. U idealnom slučaju treba uraditi maksimalni test opterećenja sa direktnim merenjem maksimalne zapremine kiseonika koju telo može da iskoristi tokom vežbanja (VO2 max) za pravilnu stratifikaciju rizika i određivanje zona vežbanja pre sastavljanja plana i programa [42]. Vežbanje, posebno ono većeg intenziteta, je kontraindikovano u nekim slučajevima kao što su prva dva dana nakon akutnog koronarnog sindroma ili u stanjima kao što su nekontrolisana aritmija, aktivni endokarditis, miokarditis ili perikarditis, simptomatska teška stenoza aorte, dekompenzovana srčana mana, akutna plućna embolija, duboka venska tromboza ili akutna disekcija aorte [42,43].

Iznenadna srčana smrt čini oko 50% od ukupnog mortaliteta u prvoj godini nakon preležanog infarkta miokarda. Bolesnici nakon preležanog infarkta miokarda često i dalje imaju faktore rizika za ishemijsku bolest srca. Potrebna je stroga kontrola ovih faktora rizika radi smanjenja rizika od daljih komplikacija i mortaliteta. Uz medikamentnu terapiju, vežbanje ima značajnu ulogu u kontroli faktora rizika [44]. Neadekvatna ishrana i fizička neaktivnost favorizuju aterosklerozu [45].

Pacijenti nakon hirurške revaskularizacije miokarda (engl. *Coronary Artery Bypass Graft* – CABG) su u riziku od novih neželjenih kardiovaskularnih događaja, aritmija i iznenadne srčane smrti [46]. Pored toga, period nakon hirurške intervencije karakteriše produženo smanjenje fizičke aktivnosti zbog dominantnog ležećeg položaja sa pratećom hipotrofijom skeletnih mišića, pogoršanja periferne cirkulacije i disfunkcije autonomnog nervnog sistema. Klinički se navedeno manifestuje izraženim smanjenjem tolerancije na fizički napor, prisustvom posturalne hipotenzije, tahikardije u mirovanju i psihološkim poremećajima, najčešće u vidu depresije ili anksioznosti. Stepen smanjenja tolerancije na napor najviše zavisi od dužine boravka u krevetu i stepena oštećenja funkcije leve komore [47]. Zbog toga je neophodna dobra kontrola faktora rizika u cilju sekundarne prevencije koronarne bolesti. Podaci pokazuju da je kod pacijenata koji nisu imali fizičku aktivnost, za godinu dana zabeleženo je oko 15% restenoze, a 88% pacijenata imalo je neželjene kardiovaskularne događaje: infarkt miokarda, moždani udar, revaskularizacione procedure ili hospitalizaciju zbog angine pektoris [48].

Nova saznanja mogu otvoriti mogućnosti za poboljšanje efekata vežbanja korišćenjem efikasnijih ili ciljanih strategija. Iako ovaj cilj može izgledati futuristički, njegove pozitivne koristi bi trebalo da budu snažna motivacija za dalja istraživanja u ovoj oblasti. U međuheart failure, acute pulmonary embolism, deep vein thrombosis, or acute aortic dissection [42,43].

Sudden cardiac death accounts for about 50% of mortality within the first year after myocardial infarction. Patients recovering from myocardial infarction often retain risk factors for ischemic heart disease, necessitating strict management to lower the risk of further complications and death. In addition to medication, exercise plays a crucial role in managing risk factors [44]. Poor diet and physical inactivity contribute to atherosclerosis [45].

Patients after coronary artery bypass grafting (CABG) remain at risk for new cardiovascular events, arrhythmias, and sudden cardiac death [46]. Additionally, the postoperative period is characterized by prolonged physical inactivity due to mostly lying in bed, which leads to skeletal muscle hypotrophy, impaired peripheral circulation, and autonomic dysfunction. Clinically, this manifests as significantly reduced exercise tolerance, postural hypotension, resting tachycardia, and psychological issues, most commonly depression or anxiety. The degree of reduced exercise tolerance mainly depends on the duration of bed rest and the severity of left ventricular dysfunction [47]. Therefore, strict management of risk factors is essential for secondary prevention of coronary disease. Data show that among patients who do not engage in physical activity, approximately 15% experience restenosis within one year, and 88% face adverse cardiovascular events, including myocardial infarction, stroke, revascularization procedures, or hospitalization for angina pectoris [48].

New findings could create opportunities to improve exercise outcomes through more efficient or targeted methods. Although this goal may seem futuristic, its potential advantages should encourage further research in this area. Meanwhile, the benefits that are already well-supported by evidence should be prioritized and implemented as critical initiatives [27,49].

It must always be emphasized that exercise programs should be safe and free from harmful effects, and that health benefits partly depend on the proper dose. The best approach is to view exercise as a therapeutic tool for cardiovascular disease. Healthcare professionals, primarily physicians, should play a role in encouraging, guiding, and promoting appropriate exercise habits in patients. The phrase "Exercise is Medicine" should go beyond simply telling patients to "exercise" or "exercise a few times per week," and instead mean that "exercise be prescribed to patients similarly to medication" [50,51]. This process begins with assessing the patient's current abilities and exercise needs,

vremenu, dokaze o prednostima koje su već očigledne treba primeniti i usvojiti kao kritične prioritete [27,49].

Stalno treba naglašavati da programi vežbanja treba da prvo budu bezbedni i bez štetnih efekata, kao i da su zdravstvene koristi, u izvesnoj meri, zavisne od doze. Kao optimalni pristup smatramo posmatranje vežbanja kao sredstva za lečenje kardiovaskularnih bolesti. Zdravstveni radnici, u prvom redu doktori medicine, treba da imaju ulogu u podsticanje, nekoj vrsti mentorskog vođenja i negovanja pravilnih navika pacijenata da vežbaju. Koncept „Vežbanje je lek" treba da ide dalje od jednostavnog govorenja pacijentima da „vežbaju" ili „vežbaju nekoliko dana u nedelji" i zahteva da se „vežbanje pacijentima propisuje na način analogan receptu za lekove" [50,51]. Umesto toga, treba početi procenom trenutnih mogućnosti i potreba pacijenta za vežbanjem i sastaviti početni program vežbanja sa određenom vrstom vežbi, njihovim intenzitetom, brojem ponavljanja i trajanjem u minutima tokom jednog dana, kao i brojem dana u kojima treba vežbati tokom nedelje. Uz to, treba iznaći načine za dodatnu motivaciju i ohrabrivanje pacijenta tokom sprovođenja programa vežbanja. Angažovanje kvalifikovanih profesionalaca je optimalni pristup za adekvatno sprovođenje programa i nadgledanje vežbanja. Sistematski pristup je moguće ostvariti kroz izmene nastavnih planova u obrazovanju lekara, na nivoima osnovnih i specijalističkih studija, uvrštavanjem nastavnih predmeta u kojima će se proučavati značaj i primena vežbanja u cilju prevencije i lečenja bolesti.

FIZIČKI TRENING U SRČANOJ INSUFICIJENCIJI

Stavovi i preporuke vodećih svetskih strukovnih organizacija kardiologa značajno su se menjali tokom prethodnih pola veka. Kao primer mogu poslužiti značajne promene u pristupu lečenju bolesnika sa insuficijencijom srca. Do osamdesetih godina dvadesetog veka obustava fizičke aktivnosti bila je jedna od terapijskih mera koja je primenjivana kod bolesnika sa ovim oboljenjem [52]. Preovladavalo je mišljenje da je fizičko vežbanje za ove bolesnike štetno, te da može dovesti do dilatacije leve komore, dekompenzacije, malignih aritmija, naprasne srčane smrti i, uopšte, do povećanja smrtnosti. Međutim, dvadesetak godina kasnije istraživanja ne samo da su negirala štetnost fizičke aktivnosti kod ovih bolesnika, već su ukazala na niz korisnih efekata [53,54]. Danas lečenje bolesnika sa insuficijencijom srca obuhvata nekoliko mogućnosti, a vežbanje je jedna od važnijih. Kod bolesnika sa srčanom insuficijencijom težak fizički rad nije preporučljiv, međutim kontrolisani fizički trening se pokazao koristan kod bolesnika sa NYHA klasom I-III (HF-ACTION) [55]. Bolesnicima sa HF potrebno je uraditi kardiopulmonalni test

then developing an initial program that specifies the type of exercise, intensity, repetitions, daily duration in minutes, and weekly sessions. Additional strategies should be employed to motivate and support the patient throughout the program. Involving qualified professionals is the most effective way to ensure proper implementation and monitoring. A structured approach can be developed by updating medical education curricula at both undergraduate and specialty-training levels, incorporating courses focused on the importance and application of exercise in disease prevention and treatment.

PHYSICAL TRAINING IN HEART FAILURE

The positions and recommendations of leading international cardiology societies have changed significantly over the past fifty years. A clear example is the major shift in how patients with heart failure are treated. Before the 1980s, stopping physical activity was considered a key treatment strategy for these patients [52]. The common belief was that exercise could be harmful and might lead to left ventricular dilatation, decompensation, dangerous arrhythmias, sudden cardiac death, and increased overall mortality. However, about twenty years later, studies not only challenged the idea that exercise was harmful but also demonstrated many health benefits [53,54]. Today, treating patients with heart failure involves multiple options, with exercise being one of the main components. Although intense physical activity is not recommended for heart failure patients, controlled physical training is beneficial for those with NYHA class I–III (HF-ACTION) [55]. Patients with heart failure should undergo a cardiopulmonary exercise test to assess their level and type of physical activity that will be prescribed, and risk stratification is essential. In patients with heart failure, physical training does not cause significant ischemia or arrhythmias; instead, it improves exercise capacity and alleviates symptoms. Cycling (stationary or regular) and walking are recommended as aerobic, dynamic forms of exercise. For patients with NYHA class II, an exercise intensity of 70%–80% of peak VO_2 is advised, while for NYHA class III patients, the recommended intensity is 50%–65% of peak VO_2, with interval training being preferred. Aerobic exercise should be performed 3–5 times per week (30–60 minutes per session), prioritizing interval training [56].

In patients with heart failure, interval training shows significantly greater improvements in left ventricular ejection fraction, along with reductions in left ventricular end-diastolic diameter and pressure, compared to continuous training. Interval training also lowers pro-B-type natriuretic peptide (pro-BNP)

fizičkim opterećenjem, radi procene nivoa i vrsta fizičke aktivnosti koji će se nakon toga sprovoditi i neophodno je izvršiti stratifikaciju rizika. Kod bolesnika sa srčanom insuficijencijom, nakon fizičkog treninga ne dolazi do značajne ishemije i aritmija, a povećava se fizički radni kapacitet i smanjuju simptomi. Preporučuje se vožnja bicikle (statičke ili obične) i pešačenje, što predstavlja aerobni, dinamički tip vežbanja. Za bolesnike NYHA II klase preporučuje se intenzitet vežbanja 70%–80% *peak* VO2, a za bolesnike NYHA III klase 50%–65% *peak* VO2, a prednost ima intervalni trening. Aerobni tip treninga se preporučuje 3–5 puta nedeljno (30–60 minuta po treningu), a prioritet ima intervalni tip treninga [56]. Kod bolesnika sa srčanom insuficijencijom intervalni trening je pokazao značajno bolje efekte na povećanje ejekcione frakcije leve komore i na smanjenje enddijastolnog dijametra i pritiska leve komore u odnosu na kontinuirani trening. Takođe intervalni trening značajnije smanjuje pro-B-tip natriuretskog peptida (pro-BNP) kod bolesnika sa srčanom insuficijencijom [57]. U HF-ACTION studiji, kod bolesnika sa srčanom insuficijencijom, fizički trening je smanjio ukupnu smrtnost i broj hospitalizacija za 11%, dok su kardiovaskularna smrtnost i hospitalizacije smanjene za 15% [48,56].

Kod bolesnika sa srčanom insuficijencijom i kaheksijom preporučuje se rezistentni tip treninga, koji je kombinacija izotoničkog i izometrijskog opterećenja. Ovu vrstu treninga treba sprovoditi dva puta nedeljno u trajanju 12–20 minuta. Ovaj vid treninga poboljšava snagu i izdržljivost skeletnih mišića i dovodi do povećanja mišićne mase [48]. Istraživanja su pokazala da u hroničnoj srčanoj insuficijenciji vežbanje inhibiše neuro-hormonalnu stimulaciju i produkciju proinflamatornih citokina [58]. Takođe, aerobni intervalni trening kod bolesnika sa HF smanjuje nivo natriuretskog peptida, sistemsku vaskularnu rezistenciju i oksidativni stres [59]. Kontrolisano vežbanje može da uspori patofiziologiju progresije srčane insuficijencije. Ovi povoljni efekti ujedno dovode do poboljšanja simptoma, fizičkog kapaciteta i kvaliteta života. Bolesnici kod kojih vežbanje ne dovodi do poboljšanja fizičkog kapaciteta imaju lošu prognozu. Intenzitet fizičkog vežbanja je izuzetno značajan. Nagle intenzivne vežbe dovode do povećanja produkcije proinflamatornih citokina i markera oštećenja endotela u bolesnika sa srčanom insuficijencijom, dok se ove promene ne vide kada se izvode umerene vežbe [58,59].

Abnormalnosti endotela su karakteristike srčane insuficijencije. Narušeni su mnogi aspekti endotelne funkcije: vazomotorna, hemo-statična, antioksidantna i inflamatorna aktivnost. Suštinske razlike u endotelnoj disfunkciji zavise od etiologije, težine i stabilnosti bolesnika sa srčanom insuficijencijom. Pokazano je da

more effectively in patients with heart failure [57]. In the HF-ACTION study, exercise training in heart failure patients decreased all-cause mortality and hospitalizations by 11%, while cardiovascular mortality and hospitalizations were reduced by 15% [48,56].

In patients with heart failure and cachexia, resistance training, including isotonic and isometric exercises, is recommended. This type of training should be performed twice weekly for 12 to 20 minutes. It enhances skeletal muscle strength and endurance and promotes muscle mass gain [48]. Research indicates that in chronic heart failure, exercise reduces neurohormonal activation and the production of pro-inflammatory cytokines [58]. Aerobic interval training in heart failure patients also lowers levels of natriuretic peptides, systemic vascular resistance, and oxidative stress [59]. Controlled exercise may slow the progression of heart failure by influencing its underlying mechanisms. These benefits improve symptoms, physical capacity, and quality of life. Patients who do not experience improvements in exercise capacity tend to have a poorer prognosis. Exercise intensity plays a crucial role. Sudden high-intensity exercise can increase the production of pro-inflammatory cytokines and markers of endothelial injury in heart failure patients, whereas such changes are not observed during moderate exercise [58,59].

Endothelial abnormalities are a key feature of heart failure. Many aspects of endothelial function are impaired, including vasomotor, hemostatic, antioxidant, and inflammatory activities. The specifics of endothelial dysfunction vary depending on the cause, severity, and stability of the heart failure. It has been shown that even in healthy individuals, moderate exercise enhances acetylcholine-induced vasodilation. Improvements in flow-mediated dilation (FMD) after exercise are associated with reverse left ventricular remodeling, significant increases in LVEF, and decreases in NT-proBNP levels [59].

Exercise intensity is crucial. Sudden high-intensity activity raises the production of pro-inflammatory cytokines and markers of endothelial injury in heart failure patients, while moderate activity does not cause such changes. Besides improving vasodilation, controlled exercise encourages reverse left ventricular remodeling, significantly enhances left ventricular ejection fraction, and reduces levels of N-terminal pro-B-type natriuretic peptide (NT-proBNP) [38,60]. Coronary endothelial dysfunction is independently linked to impaired left ventricular relaxation in patients with preserved LVEF who lack coronary artery disease. Additionally, based on the text, coronary endothelial dysfunction in coronary artery disease is connected

i kod zdravih osoba, umereni fizički trening povećava vazodilataciju indukovanu acetilholinom. Poboljšanje dilatacije brahijalne arterije, izazvana protokom (engl. *flow-mediated dilation* – FMD) nakon fizičkog treninga pratilo je reverzno remodeliranje leve komore, značajna poboljšanja LVEF i smanjenje nivoa NT-proBNP-a [59].

Intenzitet fizičkog vežbanja je izuzetno značajan. Nagle intenzivne vežbe dovode do povećanja produkcije proinflamatornih citokina i markera oštećenja endotela u bolesnika sa srčanom insuficijencijom, dok se ove promene ne vide kada se izvode umerene vežbe. Pored povećanja vazodilatacije, kontrolisane fizičke vežbe dovode do reverzije remodelovanja leve komore, značajno povećavaju ejekcionu frakciju leve komore i redukuju nivo N-terminalnog pro-B-tip natriuretskog peptida (NT-pro-BNP) [38,60]. Koronarna endotelna disfunkcija je nezavisno udružena sa narušenom relaksacijom leve komore u pacijenata sa očuvanom LVEF u odsustvu koronarne bolesti. Takođe, koronarna endotelna disfunkcija u koronarnoj bolesti udružena je sa daljim pogoršanjem dijastolne disfunkcije leve komore. Ovi nalazi su podržani time da izmenjeni balans NO doprinosi miokardnoj ishemiji izazvanoj hipertrofijom miokarda i vodi do srčane insuficijencije. Tako, oštećenje koronarnog endotela možda ima centralno mesto u srčanoj insuficijenciji [38].

ZAKLJUČAK

Kontrolisani fizički trening je izuzetno koristan kod bolesnike sa srčanom insuficijencijom. Mnoge randomizovane, kontrolisane studije su pokazale da fizički trening može usporiti patofiziološku progresiju srčane insuficijencije. U hroničnoj srčanoj insuficijenciji fizički trening inhibiše neuro-hormonalnu stimulaciju i produkciju proinflamatornih citokina, smanjuje nivo natriuretskog peptida i sistemsku vaskularnu rezistenciju i smanjuje oksidativni stres. Ovi povoljni efekti takođe povoljno utiču na simptome, fizički radni kapacitet i kvalitet života. Pacijenti od kojih fizički trening nije imao povoljne efekte na fizički radni kapacitet imaju lošu prognozu.

Intenzitet i vrsta fizičkog treninga su izuzetno bitni. Stalno treba naglašavati da programi vežbanja treba da prvo budu bezbedni i bez štetnih efekata, kao i da su zdravstvene koristi, u izvesnoj meri, zavisne od doze. Kod bolesnika sa srčanom insuficijencijom, aerobni intervalni trening je mnogo efikasniji od moderiranog kontinuiranog treninga. Pokazano je da i kod zdravih osoba, umereni fizički trening povećava vazodilataciju indukovanu acetilholinom. Poboljšanje FMD nakon fizičkog treninga izaziva reverziju remodelovanja leve komore, povećava ejekcionu frakciju leve komore i smanjuje nivo NT-pro-BNP.

with further deterioration of left ventricular diastolic dysfunction. These findings are supported by evidence that changes in nitric oxide balance contribute to myocardial ischemia caused by myocardial hypertrophy and lead to heart failure. Therefore, coronary endothelial injury may play a central role in the pathophysiology of heart failure [38].

CONCLUSION

Controlled physical training is highly beneficial for patients with heart failure. Numerous randomized, controlled trials have shown that exercise can slow the progression of heart failure's underlying causes. In chronic heart failure, physical training reduces neurohormonal activation and pro-inflammatory cytokine production, lowers levels of natriuretic peptides and systemic vascular resistance, and decreases oxidative stress. These positive effects also enhance symptoms, exercise capacity, and quality of life. Patients who do not see improvements in exercise capacity from physical training tend to have a poorer prognosis.

The intensity and type of exercise are critically important. Exercise programs must always be safe and free of harmful effects, and the health benefits depend, to some extent, on dose. In patients with heart failure, aerobic interval training is significantly more effective than moderate continuous training. Even in healthy individuals, moderate exercise increases acetylcholine-induced vasodilation. Improved FMD after exercise leads to reverse left ventricular remodeling, increases left ventricular ejection fraction, and reduces NT-proBNP levels.

Healthcare professionals, especially physicians, should play a crucial role in encouraging, guiding, and promoting proper exercise habits in patients. The process should start with an assessment of the patient's current exercise capacity and needs, followed by the development of an initial training program that specifies the type of exercise, intensity, repetitions, duration in minutes per day, and the number of exercise days per week. Additional strategies should be used to motivate and support patients throughout the program. Involving qualified professionals is the best way to ensure proper implementation and monitoring of the exercise program.

Conflict of interest: None declared.

Zdravstveni radnici, u prvom redu doktori medicine, treba da imaju ulogu u podsticanju, nekoj vrsti mentorskog vođenja i negovanja pravilnih navika pacijenata da vežbaju. Treba početi procenom trenutnih mogućnosti i potreba pacijenta za vežbanjem i sastaviti početni program vežbanja sa određenom vrstom vežbi, njihovim intenzitetom, brojem ponavljanja i trajanjem u minutama tokom jednog dana, kao i brojem dana u kojima treba vežbati tokom nedelje. Uz to, treba iznaći načine za dodatnu motivaciju i ohrabrivanje pacijenta tokom sprovođenja programa vežbanja. Angažovanje kvalifikovanih profesionalaca je optimalni pristup za adekvatno sprovođenje programa i nadgledanje vežbanja.

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