Rekreacija u bolesnika s kardiovaskularnim bolestima: usmjerenost na zračni prijevoz i *wellness*

Recreation in Patients with Cardiovascular Disease: Focus on Air Travel and Wellness

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SAŽETAK: Tijekom rehabilitacijskoga procesa pitanje rekreacijskih aktivnosti obično se postavlja u fazi rekonvalescencije. Rekreacija obuhvaća tjelesne i/ili mentalne aktivnosti koje zadovoljavaju psihološki i biološki uvjetovane potrebe. Turizam uključuje i tjelesne i mentalne rekreacijske elemente. U kontekstu udaljenih odredišta, korištenje zračnim prijevozom otvara niz zdravstvenih pitanja, dok domaći turizam često uključuje posjete toplicama i saunama, što također može značiti rizik za bolesnike s kardiovaskularnim (KV) bolestima. Putnici su tijekom leta izloženi fizikalnim, psihološkim i fiziološkim utjecajima koji mogu uzrokovati pojavu smetnji, najčešće palpitacije i bol u prsima. Boravak u termalnim kupkama i saunama popularan je oblik rekreacije, ali može biti zabrinjavajući u bolesnika s KV bolestima. Stupanj povišenja temperature i posljedični utjecaj na cirkulaciju različit je kod kupki i sauna, zbog čega se ove aktivnosti ne mogu bezrezervno preporučiti navedenim bolesnicima. U ovom ćemo preglednom radu predstaviti fiziološke posljedice zračnoga prijevoza na ljudski organizam te pružiti sažetak međunarodne literature i smjernica o zračnom prijevozu pri različitim KV stanjima. Nadalje, detaljno ćemo opisati promjene u krvotoku uzrokovane finskom i infracrvenom saunom, kao i kupkama u vrućoj vodi, te raspraviti o mogućim kontraindikacijama za te aktivnosti.

SUMMARY: During the rehabilitation process, the question of recreational activities typically arises in the convalescent phase. Recreation encompasses physical and/or mental activities that fulfill a psychologically and biologically determined need. Tourism includes both physical and mental recreational elements. Regarding distant destinations, air travel raises several concerns, just as domestic tourism frequently involves visits to spas and saunas, both of which may pose risks for patients with cardiovascular conditions. Air travel exposes passengers to physical, psychological, and physiological effects, which can lead to cardiac symptoms, most commonly palpitations and chest pain. Visiting thermal baths and saunas is a popular recreational activity, but it can also be concerning for patients with cardiovascular disease. The degree of temperature elevation and its impact on circulation differ between baths and saunas, making them not universally recommended for these patients. In this review, we summarize the physiological effects of air travel on the human body, as well as international literature and guidelines regarding air travel in various cardiovascular conditions. Furthermore, we detail the circulatory changes induced by Finnish and infrared saunas, as well as hot water baths, and discuss their potential contraindications.

KLJUČNE RIJEČI: kardiovaskularne bolesti, rekreacija, zračni prijevoz, sauna, termoterapija.

KEYWORDS: cardiac diseases, recreation, aviation, sauna, heat therapy.

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Pojam rekreacije

Tijekom rehabilitacijskoga procesa pitanje rekreacijske aktivnosti ponajprije se otvara u fazi rekonvalescencije, kao sastavni dio povratka svakod-

The concept of recreation

In the course of the rehabilitation process, the issue of recreational activity primarily arises during the convalescent phase as an integral com-

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nevnom funkcioniranju. Rekreacija je dio kulture provođenja slobodnoga vremena te zadovoljava temeljnu ljudsku potrebu koja proizlazi i iz psihološke i iz biološke perspektive. Rekreacija obuhvaća širok raspon tjelesnih, intelektualnih, kulturnih i sportskih aktivnosti s pomoću kojih pojedinac umanjuje napetost i iscrpljenost koje se nakupljaju tijekom svakodnevne primarne djelatnosti, sa svrhom obnove i unaprjeđenja tjelesnih, umnih i psiholoških sposobnosti i kapaciteta. Vrlo sažeto rečeno, glavni se cilj rekreacije može definirati kao „sudjelovanje u aktivnostima koje se razlikuju od onoga čime se obično bavimo"[1].

Prema Mađarskom etimološkom rječniku, pojam rekreacija potječe od latinske riječi *recreare*, što znači „osvježiti" ili „obnoviti", a izvedena je od sastavnica *re* („ponovno") i *creare* („stvoriti").

Rekreacija obuhvaća raznolik raspon aktivnosti. Većina relevantne literature razlikuje tri temeljna područja: intelektualnu rekreaciju, tjelesnu rekreaciju te turizam. Intelektualne rekreacijske aktivnosti uključuju kulturne, zabavne i obrazovne sadržaje, dok se tjelesna rekreacija odnosi na tjelesnu aktivnost ili sport u kojoj sudjelujemo dobrovoljno, radi zadovoljstva, a ne zbog obveze. Turizam, osobito odmorišni turizam, čini zasebnu treću kategoriju; međutim, opseg aktivnosti obuhvaćenih turizmom uključuje i elemente intelektualne i tjelesne rekreacije[2].

Fiziološki i zdravstveni učinci zračnoga prijevoza

U bolesnika s kardiovaskularnim (KV) bolestima putovanje može biti povezano s povećanom razinom rizika, pa je stoga i primjereno da te osobe prije planiranog putovanja od svojeg liječnika traže savjet i preporuke. Pri putovanju u inozemstvo, osobito na veće udaljenosti, zračni je prijevoz najčešći oblik prijevoza do odredišta.

Zračni prijevoz vezan je uz specifične izazove i nedoumice, od kojih su neke subjektivne prirode, dok druge značе stvarne rizike. I u zdravih osoba letenje može uzrokovati određeno fiziološko opterećenje, a mogućnost nastanka hitnoga medicinskog stanja tijekom leta može biti značajan izvor anksioznosti. Taj je strah osobito izražen u bolesnika s KV bolestima. Dostupnost je preciznih podataka o učestalosti i obilježjima tzv. hitnih medicinskih stanja tijekom leta ograničena, ponajprije zbog nepostojanja standardiziranih međunarodnih registara[3,4].

Prema skupnoj analizi podataka gotovo 12 000 putnika, jedno hitno medicinsko stanje pojavljuje se na približno svaka 604 leta[5]. Drugi izvori procjenjuju učestalost hitnih medicinskih stanja tijekom letova u rasponu od 26 do 130 događaja na milijun putnika[6,7]. Međutim, izgledno je da je stvarna učestalost hitnih medicinskih stanja i veća jer se prolazna stanja koja spontano prestaju ili ne zahtijevaju medicinsku intervenciju često ne prijavljuju niti službeno bilježe[8]. Učestalost hitnih kardioloških stanja tijekom leta procjenjuje se na približno 5 slučajeva na milijun putnika, pri čemu su palpitacije i bol u prsima najčešće zabilježeni simptomi[9].

Zračni se prijevoz bitno razlikuje od kopnenoga prijevoza zbog specifičnih okolišnih uvjeta prilikom leta pri kojem su putnici izloženi spoju fizioloških, fizikalnih i psiholoških stresora. Psihološki je stres prije svega povezan s vremenom čekanja i sigurnosnim provjerama prije leta, dok fizički stres uzrokuju dugotrajno stajanje u redovima, nošenje prtljage te dugo hodanje unutar aerodromskih terminala. Navedeni čimbenici mogu biti dodatno pogoršani geografskim obilježjima odredišta, poput okolišne temperature ili nadmorske visine,

ponent of returning to everyday functioning. Recreation, or leisure activity, represents the culture of spending free time and fulfills a fundamental human need established from both psychological and biological perspectives. It encompasses a wide range of physical, intellectual, cultural, and sporting activities, through which individuals relieve the tension and fatigue accumulated during their primary daily occupation, with the aim of restoring and enhancing physical, mental, and psychological performance capacity. In very concise terms, the primary objective of recreation can be defined as "engagement in activities different from one's usual occupation"[1].

According to the Hungarian Etymological Dictionary, the term *recreation* originates from the Latin word *recreare*, meaning "to refresh" or "to restore," derived from the elements *re* ("again") and *creare* ("to create").

Recreation comprises a diverse spectrum of activities. The majority of the relevant literature distinguishes three principal domains: intellectual, physical recreation and tourism. Intellectual recreational activities include cultural, entertainment, and educational pursuits, whereas physical recreation refers to physical activity or sport performed voluntarily, for pleasure rather than obligation. Tourism, particularly leisure tourism, constitutes an independent third category; however, its range of activities incorporates elements of both intellectual and physical recreation[2].

Physiological and health-related effects of air travel

For patients living with cardiovascular disease, travel may be associated with an increased level of risk. Consequently, patients appropriately seek advice and guidance from their treating physicians prior to undertaking travel. When travelling abroad, particularly over long distances, air travel is typically the mode of transportation.

Air travel presents unique challenges and concerns, some of which are perceived, while others represent real risks. Even for healthy individuals, flying may impose a physiological burden, and the occurrence of an in-flight medical emergency can be a source of significant anxiety. This concern is particularly pronounced among individuals with cardiovascular disease. Precise data regarding the incidence and characteristics of so-called in-flight medical emergencies (IMEs) are limited, primarily due to the absence of standardized international registries[3,4].

According to a summary analysis evaluating data from nearly 12,000 passengers, one medical emergency occurs in approximately 1 out of every 604 flights[5]. Other sources estimate the incidence of in-flight medical emergencies to range between 26 and 130 events per one million passengers[6,7]. However, the true incidence is likely higher, as transient conditions that resolve spontaneously or do not require medical intervention are often not reported or formally documented[8]. The incidence of in-flight cardiac emergencies has been estimated at approximately 5 cases per one million passengers, with palpitations and chest pain being the most commonly reported symptoms[9].

Air travel fundamentally differs from ground transportation due to its unique environmental conditions, exposing passengers to a combination of physiological, physical, and psychological stressors. Psychological stress is primarily related to waiting times and security procedures, whereas physical stress includes prolonged standing in queues, carrying luggage, and extensive walking within airport terminals. These factors may be further exacerbated by destination-specific geographical characteristics, such as ambient tempera-

kao i promjenom vremenskih zona i nedostatkom sna povezanim s putovanjem[9].

Fiziološki učinci leta u velikoj su mjeri posljedica promjena tlaka u kabini te temperature i volumena plinova u zrakoplovu. Iako je temperatura u kabini tijekom leta uglavnom stabilna, atmosferski tlak i parcijalni tlak kisika s vremenom se postupno smanjuju. Ta promjena može izazvati simptome u bolesnika s KV ili plućnim bolestima. Nadalje, promjene tlaka tijekom leta mogu dovesti do širenja zaostaloga zraka u tijelu koji može ostati zarobljen nakon određenih medicinskih zahvata, primjerice operacije na otvorenom srcu, što može imati značajne hemodinamske posljedice[9].

Apsolutne kontraindikacije za zračni prijevoz

Korištenje zračnim prijevozom apsolutno je kontraindicirao u sljedećim stanjima[10-15]:

- dva do šest tjedana nakon akutnog infarkta miokarda (u slučajevima bez komplikacija dva tjedna nakon infarkta)
- nestabilna angina pektoris
- dekompenzirano zatajivanje srca
- teška, simptomatska valvularna bolest srca povezana s akutnom dekompenzacijom ili cijanotična urođena srčana bolest
- nakon iznenadnog zastoja srca s uspješnom reanimacijom, bez implantacije implantabilnog kardioverterskog defibrilatora, ako je ejekcijska frakcija lijeve klijetke trajno na <35 % ili ako u prvih šest mjeseci nije utvrđen reverzibilni uzrok zastoja
- nekontrolirane ventrikularne ili supraventrikularne aritmije
- unutar dva tjedna nakon kirurškog premoštenja koronarnih arterija ili drugih kirurških zahvata na otvorenom srcu
- disekcija aorte tipa A prema Stanfordskoj klasifikaciji
- nekontrolirana arterijska hipertenzija.

Detaljne preporuke za pojedina kardiovaskularna stanja

Detaljne preporuke za putovanje zrakoplovom ovisno o vrsti KV bolesti prikazane su u **tablicama 1-3**.

Kronični koronarni sindrom i zračni prijevoz

ture or altitude above sea level, as well as by time zone shifts and travel-related sleep deprivation[9].

Physiological effects during flight are largely attributable to changes in cabin pressure, temperature, and gas volume. While cabin temperature generally remains stable throughout the flight, both ambient pressure and the partial pressure of oxygen decrease. This reduction may provoke symptoms in patients with cardiovascular or pulmonary disease. Furthermore, pressure changes during flight may lead to the expansion of trapped air following certain medical interventions, such as open-heart surgery, potentially resulting in significant hemodynamic consequences[9].

Absolute contraindications to air travel

Air travel is absolutely contraindicated in the following conditions[10-15]:

- two to six weeks following an acute myocardial infarction, (in an uncomplicated case for two weeks)
- unstable angina
- decompensated heart failure
- severe, symptomatic valvular heart disease associated with acute decompensation or cyanotic congenital heart disease
- following sudden cardiac arrest with successful resuscitation, in the absence of implantable cardioverter-defibrillator (ICD) implantation, if the left ventricular ejection fraction (LVEF) remains persistently below 35%, or in the absence of a correctable reversible cause during the first six months
- uncontrolled ventricular or supraventricular arrhythmias
- within two weeks following coronary artery bypass grafting (CABG) or other open-heart surgery
- Stanford type A aortic dissection
- uncontrolled hypertension.

Detailed recommendations for specific cardiovascular conditions

Detailed recommendations for air travel based on the type of cardiovascular disease are shown in **Tables 1-3**.

Chronic Coronary Syndrome and Air Travel

TABLE 1. Recommendations for air travel in chronic coronary syndrome according to the Canadian Cardiovascular Society classification - based on the Canadian Cardiovascular Society [CCS] Angina Classification)[12,16,17].

Clinical status	Medical recommendation
CCS I-II	No restrictions regarding air travel
CCS III	• airport assistance is recommended • potential need for in-flight oxygen supplementation
CCS IV	Air travel is not recommended
Chronic coronary syndrome + uncomplicated PCI	No restrictions after 2–3 days following the intervention
Chronic coronary syndrome + uncomplicated but complex PCI	Air travel is recommended after 5–7 days following the intervention
Chronic coronary syndrome + complicated PCI	e.g. coronary dissection, access-site complications – individualized assessment is required
Chronic Coronary Syndrome + CABG	air travel is recommended after 10–14 days following surgery, provided the patient is hemodynamically stable, asymptomatic, and wound healing is satisfactory

CCS = Canadian Cardiovascular Society Angina Classification; PCI = percutaneous coronary intervention; CABG = coronary artery bypass grafting

Akutni koronarni sindrom i zračni prijevoz | *Acute Coronary Syndrome and Air Travel*

TABLE 2. Recommendations for air travel following acute coronary syndrome[9,11,12].

Clinical status	Medical recommendation
Uncomplicated ACS	**No restrictions within 3-7 days if:** • left ventricular ejection fraction (LVEF) >50% • age <65 years • no mechanical complications are present • no electrolyte disturbances are present
ACS with mild complications	• no restriction after 10-14 days if LVEF is 40-50% and symptoms are mild (CCS class II) • no restrictions after 4-6 weeks if LVEF <40% and CCS class II-III symptoms are present
ACS with severe complications	**Air travel is contraindicated in the presence of:** • mechanical complications (septal rupture, free wall rupture, papillary muscle rupture) • arrhythmias (ventricular tachycardia, ventricular fibrillation, tachy-fibrillation, atrioventricular block)

ACS = acute coronary syndrome; CCS = Canadian Cardiovascular Society Angina Classification; LVEF = left ventricular ejection fraction.

Zatajivanje srca i zračni prijevoz | *Heart Failure and Air Travel*

TABLE 3. Recommendations for air travel in patients with heart failure[9,11,12,16,17].

Clinical status	Medical recommendation
Acute HF, NYHA class IV	air travel may be considered 6–8 weeks after hospital discharge
Chronic HF, NYHA class II	no restrictions regarding air travel
Chronic HF, NYHA class III	• airport assistance is recommended • potential need for in-flight oxygen supplementation
End-stage HF, NYHA class IV	• air travel should generally be avoided • if unavoidable, travel may be undertaken with airport assistance and oxygen supplementation
LVAD	**following recent implantation:** • air travel is contraindicated within the first 8 weeks
	3-6 months after the implantation: • air travel should be considered only if necessary • airport assistance is compulsory • recent INR values, medical documentation, and fully charged batteries must be available • adequate hydration should be ensured, caffeine intake should be avoided

HF = heart failure; NYHA = New York Heart Association Functional Classification; LVAD = left ventricular assist device.

Zračni prijevoz nakon ugradnje srčanih uređaja i kirurškog zahvata na otvorenom srcu

Nakon kirurškog zahvata na otvorenom srcu, korištenje zračnim prijevozom u pravilu se ne preporučuje barem 10 – 14 dana nakon operacije, čak i u slučajevima bez komplikacija. Razlog je takvoj preporuci mogućnost zaostajanja intratorakalnoga zraka – primjerice asimptomatskog pneumotoraksa, pneumoperikarda ili pneumomedijastinuma – koji se može zadržati nakon kirurškog zahvata te se na većim visinama, zbog smanjenja atmosferskoga tlaka, može proširiti i dovesti do klinički značajnih posljedica.

Air travel following device implantation and open-heart surgery

Following open-heart surgery, air travel is generally recommended no earlier than 10–14 days postoperatively, even in uncomplicated cases. The rationale for this recommendation is that residual intrathoracic air—such as asymptomatic pneumothorax, pneumopericardium, or pneumomediastinum—may remain trapped after surgery and can expand at higher altitudes due to reduced ambient pressure, potentially leading to clinically significant consequences.

Zbog sličnih razloga, nakon ugradnje elektrostimulatora srca ili drugoga elektroničkoga srčanog uređaja, zračni prijevoz treba odgoditi za najmanje dva tjedna nakon zahvata ako je zahvat doveo do pneumotoraksa kao komplikacije. U slučajevima bez komplikacija bolesnici mogu putovati zrakoplovom već dva dana nakon zahvata, pod uvjetom da je osigurana adekvatna kontrola boli.

Nakon invazivnih elektrofizioloških zahvata korištenje zračnim prijevozom u pravilu se preporučuje tek nakon sedam dana, čak i u slučajevima bez komplikacija, zbog rizika od tromboembolijskih događaja – osobito nakon kateterizacije lijeve strane srca. U iznimnim i dobro opravdanim okolnostima bolesnicima se može dopustiti let već dva dana nakon zahvata. Slično tomu, korištenje zračnim prijevozom nakon strukturnih intervencija na srcu može se preporučiti nakon sedam dana, ako nisu prisutne dodatne komplikacije.

Bolesnicima s ugrađenim srčanim uređajima općenito se preporučuje da sa sobom nose identifikacijsku iskaznicu uređaja te vezanu medicinsku dokumentaciju, uključujući i rezultate nedavno provedenog elektrokardiograma. Pacijenti bi o prisutnosti ugrađenog uređaja trebali obavijestiti osoblje koje provodi sigurnosne kontrole u zračnoj luci, izbjegavati prinošenje ručnih detektora metala u neposrednu blizinu uređaja te vrijeme provedeno u neposrednoj blizini sustava za detekciju metala svesti na minimum[9].

WELLNESS

Wellness programi i posjeti lječilištima iznimno su popularni među oblicima rekreacije koji ne uključuju putovanje u druge zemlje, osobito s obzirom na prirodna bogatstva Mađarske. Stoga se u rehabilitacijskoj i kardiološkoj praksi često postavlja pitanje sigurnosti korištenja saunama i toplicama. Kako bi se mogle dati odgovarajuće preporuke, nužno je dobro poznavati različite oblike pasivne izloženosti toplini te njihove fiziološke učinke na ljudski organizam.

Tradicionalna finska sauna oblik je pasivne termoterapije, obilježen visokom temperaturom u rasponu od 80 do 100 °C, niskom relativnom vlagom zraka od približno 10 – 20 % te primjenom opetovanih kratkotrajnih izlaganja u trajanju od 5 do 20 minuta. Infracrvene saune obično rade pri nižim temperaturama (40 – 60 °C), a uporabljuju se u više uzastopnih primjena u trajanju od 15 do 30 minuta. Kupke u toploj vodi najčešće imaju temperaturu između 38 i 42 °C; no u tim je uvjetima, osim toplinskog učinka, potrebno uzeti u obzir i fiziološki utjecaj hidrostatskoga tlaka.

Učinci različitih oblika izlaganja toplini na kardiovaskularni sustav

Porast tjelesne temperature

Svi oblici pasivne izloženosti toplini dovode do porasta tjelesne temperature, što posljedično pokreće niz hemodinamskih promjena. U finskoj sauni ezofagealna temperatura može dosegnuti 39 °C unutar 10 minuta[18]. Unatoč nižoj temperaturi, korištenje infracrvenom saunom može uzrokovati porast tjelesne temperature za 1,0 – 1,2 °C unutar 15 minuta[19,20]. Tijekom kupanja u toploj vodi uranjanje do razine ramena u vodu temperature 41 °C u razdoblju od 10 minuta dovodi do sličnog porasta temperature od 1,0 do 1,2 °C. Takav se učinak kupke može pripisati približno 24 puta većoj toplinskoj vodljivosti vode u usporedbi sa zrakom, kao i izostanka evaporativnog hlađenja znojenjem[20].

For similar reasons, after implantation of any type of pacemaker or other cardiac electronic device, air travel should be postponed for at least two weeks, if complicated by pneumothorax. In uncomplicated cases, patients may fly as early as two days after the procedure, provided that adequate pain control has been ensured.

Following invasive electrophysiological procedures, air travel is generally recommended after seven days, even in uncomplicated cases, due to the risk of thromboembolic events—particularly after left-sided cardiac catheterization. In exceptional and well-justified circumstances, patients may be permitted to fly as early as two days after the procedure. Similarly, following structural cardiac interventions, air travel may be recommended after seven days in the absence of complications.

For patients with implanted cardiac devices, it is generally recommended that they carry their device identification card along with relevant medical documentation, including a recent electrocardiogram. Patients should inform airport security personnel about the presence of the implanted device, avoid placing handheld metal detectors directly over the device, and minimize the time spent in close proximity to metal detection systems[9].

WELLNESS

Among domestic recreational options, particularly in light of Hungary's natural resources, wellness programs and spa visits are highly popular. Consequently, questions regarding the safety of sauna and spa use frequently arise in both rehabilitation and cardiology practice. In order to provide appropriate recommendations, it is essential to understand the different forms of passive heat exposure and their physiological effects on the human body.

The traditional Finnish sauna represents one form of passive heat therapy, characterized by high temperatures ranging from 80 to 100°C, low humidity levels of approximately 10–20%, and repeated short exposure sessions lasting 5–20 minutes. Infrared saunas are typically operated at lower temperatures (40–60°C) and are used in repeated sessions lasting 15–30 minutes. Warm-water baths generally have temperatures between 38 and 42°C; however, in these settings, not only thermal effects but also the physiological impact of hydrostatic pressure must be taken into account.

EFFECTS OF DIFFERENT HEAT MODALITIES ON THE CARDIOVASCULAR SYSTEM

Increase in core body temperature

All forms of passive heat exposure lead to an increase in core body temperature, which in turn initiates a range of hemodynamic changes. In the case of the Finnish sauna, esophageal temperature may reach 39°C within 10 minutes[18]. Despite the lower ambient temperature, infrared sauna use may result in a 1.0–1.2°C increase in core body temperature within 15 minutes[19,20]. During warm-water bathing, shoulder-level immersion in 41°C water for 10 minutes induces a similar 1.0–1.2°C rise in core temperature. This effect is attributable both to the approximately 24-fold greater thermal conductivity of water compared with air and to the absence of evaporative cooling through sweating[20].

Promjene u kožnoj cirkulaciji i znojenju

Porastom tjelesne temperature dolazi do povećanja temperature kože, što uzrokuje perifernu vazodilataciju i znojenje, najčešće pri porastu tjelesne temperature od približno 0,4 °C[21]. Zbog prirode njezina toplinskog opterećenja finska sauna dovodi do izraženijeg znojenja pri usporedivom porastu temperature tijela s obzirom na ostale modalitete. U osoba naviknutih na saunu gubitak tekućine znojenjem može dosegnuti i do 1,3 L/sat[22].

Porast frekvencije srca i minutnog volumena srca

Porast tjelesne temperature od 1 °C povezan je s povećanjem frekvencije srca za približno 30 otkucaja u minuti. Tijekom boravka u finskoj sauni frekvencija može dosegnuti 120 – 150 otkucaja u minuti, dok je porast koji se bilježi pri korištenju infracrvenom saunom i tijekom kupanja u toploj vodi uglavnom manje izražen[22-25]. Izloženost toplini također dovodi do povećanja minutnog volumena srca. Tijekom kupanja u toploj vodi minutni volumen može porasti za 60 – 140 %, dok boravak u finskoj sauni uzrokuje porast koji ovisi o trajanju izlaganja i temperaturi, a kreće u rasponu od blagih povećanja do približno 75 %. Infracrvena sauna povećava minutni volumen srca za 30 – 50 %[26].

Intrakardijalni tlakovi i udarni volumen

Pasivna izloženost toplini dovodi do promjena u intrakardijalnom tlaku i udarnog volumenu koje ovise o modalitetu izloženosti. U svim slučajevima dolazi do redistribucije cirkulacije uz porast tjelesne temperature. U finskoj i infracrvenoj sauni, gdje hidrostatski tlak nema ulogu, smanjuju se tlak u desnom atriju i tlakovi punjenja lijeve klijetke[27,28]. S duge strane, hidrostatski tlak povećava venski povrat krvi tijekom uranjanja u toplu vodu, što dovodi do porasta svih intrakardijalnih tlakova. S obzirom na ovu ključnu razliku, korištenje saunom može biti sigurnije za bolesnike sa zatajivanjem srca u usporedbi s kupanjem u toploj vodi[20]. Međutim, hemodinamske promjene izazvane uranjanjem u toplu vodu usporedive su s onima koje se opažaju tijekom tjelesne aktivnosti umjerenog intenziteta, što upućuje na to da kupanje u toploj vodi može biti učinkovitije u poticanju KV adaptacije[26]. Toplinsko opterećenje ne uzrokuje značajne promjene u udarnom volumenu, a znatne razlike nisu zabilježene ni pri usporedbi uporabe saune i kupanja u toploj vodi[20].

Arterijski tlak

Periferno širenje krvnih žila inducirano toplinom smanjuje sistemski cirkulacijski otpor, što dovodi do sniženja sistoličkog i dijastoličkog arterijskog tlaka tijekom boravka u finskoj i infracrvenoj sauni. S druge strane, hidrostatski tlak djelomično ublažuje pad dijastoličkoga tlaka tijekom kupanja u toploj vodi[20]. Snizivanje arterijskoga tlaka nakon pasivne izloženosti toplini može potrajati do 60 minuta nakon prestanka izlaganja, slično hipotenziji koja se može opaziti nakon tjelesne aktivnosti[25]. **Tablica 4** prikazuje hemodinamske promjene uzrokovane različitim oblicima toplinskog opterećenja.

Od oblika pasivne izloženosti toplini koje smo razmotrili, učinak tradicionalne finske saune najpodrobnije je istražen. Povoljni KV učinci korištenja saunom dobro su potkrijepljeni dokazima; međutim, u osoba s postojećom KV bolešću mogući štetni učinci mogu biti uzrok zabrinutosti. Finski su istraživači ispitali sigurnost korištenja saunom u širokom rasponu različitih populacija te nisu zabilježili štetne učinke u boles-

Changes in cutaneous circulation and sweating

As core body temperature rises, skin temperature increases, leading to peripheral vasodilation and the onset of sweating, which typically occurs when core temperature increases by approximately 0.4°C[21]. Owing to the nature of heat exposure, the Finnish sauna induces a greater degree of sweating than other modalities at comparable levels of core temperature elevation. In sauna-acclimatized individuals, sweat-induced fluid loss may reach up to 1.3 L/hour[22].

Increase in heart rate and cardiac output

An increase in body temperature of 1°C is associated with an approximate rise of 30 beats per minute in heart rate. During Finnish sauna exposure, heart rate may reach 120–150 beats per minute, whereas the increase observed with infrared sauna use and warm-water bathing is generally less pronounced[22–25]. Heat exposure also leads to an increase in cardiac output. During warm-water bathing, cardiac output may increase by 60–140%, while Finnish sauna use results in variable increases depending on exposure duration and temperature, ranging from mild elevations up to approximately 75%. Infrared sauna use increases cardiac output by 30–50%[26].

Intracardiac pressures and stroke volume

Passive heat exposure results in modality-specific changes in intracardiac pressures and stroke volume. Redistribution of the circulation occurs in all cases as body temperature rises. In Finnish and infrared saunas, where hydrostatic pressure does not play a role, right atrial pressure and left ventricular filling pressures decrease[27,28]. In contrast, during warm-water immersion, hydrostatic pressure increases venous return, leading to elevations in all intracardiac pressures. Based on this key difference, sauna use may be safer for patients with heart failure compared with warm-water bathing[20]. However, the hemodynamic changes induced by warm-water immersion are comparable to those observed during moderate-intensity physical exercise, suggesting that warm-water bathing may be more effective in promoting cardiovascular adaptation[26]. Stroke volume does not change significantly in response to heat exposure, and no meaningful differences have been observed when comparing sauna use with warm-water bathing[20].

Blood pressure

Heat-induced peripheral vasodilation reduces systemic vascular resistance, resulting in a decrease in systolic and diastolic blood pressure during Finnish and infrared sauna use. During warm-water bathing, however, the hydrostatic pressure partially counteracts the reduction in diastolic blood pressure[20]. The blood pressure–lowering effect of passive heat exposure may persist for up to 60 minutes after cessation of heat exposure, similar to the post-exercise hypotensive response observed following physical activity[25]. **Table 4** summarizes the hemodynamic changes induced by different heat modalities.

Among the passive heat modalities discussed, traditional Finnish sauna is the most extensively studied. The beneficial cardiovascular effects of sauna bathing are well established; however, concerns may arise regarding potential adverse effects in individuals with pre-existing cardiovascular disease. Finnish investigators have examined the safety of sauna bathing in a wide range of populations and have reported no

TABLE 4. Cardiovascular effects of different heat modalities[18-20,22-28].

Heat modality	Heart rate	Cardiac output	Intracardiac pressure	Stroke volume	Blood pressure
Finnish sauna	↑↑	~75% ↑	↓	↔/↑	↓
Infrared sauna	↑↑	30-50% ↑	↓	↔/↑	↓
Warm-water bathing	↑	60-140% ↑	↑	↔	↔/↓

nika sa stabilnom koronarnom bolesti srca, zatajivanjem srca ili arterijskom hipertenzijom[29-31]. Važno je naglasiti da su ispitanici bili iz finske populacije koja se, u pravilu, redovito koristi saunom, često nekoliko puta tjedno, što vjerojatno dovodi do znatne hemodinamske adaptacije.

S druge strane, važno je da ni istraživanja provedena u populacijama koje su manje naviknute na uporabu saune nisu pokazala povećanu učestalost štetnih događaja povezanih s korištenjem saunom, pod uvjetom da se ona primjenjuje unutar sigurnosnih granica[32,33]. U bolesnika s koronarnom bolesti srca teoretski je moguć nastanak ishemije miokarda kao posljedice toplinom induciranog porasta frekvencije srca, slično kao kod fizioloških posljedica koje nastaju tijekom tjelesnog napora. Stoga se tijekom korištenja saunom preporučuje provedba kontrole frekvencije srca. Održavanje ciljanih vrijednosti frekvencije srca koje su prethodno određene u sklopu strukturiranog programa KV rehabilitacije može smanjiti rizik od angine pektoris ili latentne ishemije miokarda.

Moguće povećanje rizika od aritmija i iznenadne srčane smrti također je pitanje koje se često postavlja u ovom kontekstu. U istraživanju na 98 bolesnika s anamnestičkim podatcima o akutnom infarktu miokarda, aritmijski događaji tijekom boravka u sauni zabilježeni su u samo 8 % ispitanika, u usporedbi s učestalošću od 18 % tijekom sub-maksimalnog tjelesnog opterećenja[26]. U većini zabilježenih slučajeva iznenadne srčane smrti povezane s korištenjem saunom, pokazalo se da je konzumacija alkohola bila pridonoseći čimbenik. Konzumacija alkohola tijekom korištenja saunom povećava rizik od hipotenzije, KV komplikacija i slučajnih tjelesnih ozljeda[24].

U osoba koje se prethodno nisu redovito koristile saunom tijekom njezine uporabe mogu se pojaviti neočekivane nuspojave. Stoga se u osoba bez prethodnog iskustva s korištenjem saunom preporučuje primjena posebnih sigurnosnih mjera, uključujući kraće trajanje boravka u sauni, dulja razdoblja oporavka između ciklusa, primjerenu nadoknadu tekućine te izbjegavanje uranjanja u hladnu vodu. Nadalje, ovoj se populaciji ne preporučuje korištenje saunom bez nadzora ili bez prisutnosti druge osobe.

Kontraindikacije

Boravak u sauni u bilo kojem obliku, kao i korištenje kupkama s toplom vodom, jasno su kontraindicirani u osoba sa sljedećim stanjima[26]:

- nestabilna angina pektoris
- bilo koje nestabilno kliničko stanje
- teška aortalna stenoza
- nedavni infarkt miokarda
- nedavni tranzitorni ishemijski napadaj ili moždani udar
- stariji bolesnici s ortostatskom hipotenzijom.

adverse effects in patients with stable coronary artery disease, heart failure, or hypertension[29-31]. It is important to note that the Finnish population studied typically engage in sauna bathing regularly, often several times per week, which likely results in significant hemodynamic adaptation.

Importantly, studies conducted in less sauna-acclimatized populations have likewise not demonstrated adverse events associated with sauna use when performed within safe limits[32,33]. In patients with coronary artery disease, myocardial ischemia may theoretically occur as a consequence of heat-induced increase in heart rate, similar to the physiological response observed during physical exertion. Therefore, the application of heart rate control during sauna bathing may be advisable. Adherence to the heart rate ranges determined and applied during structured cardiac rehabilitation exercise programs may reduce the risk of angina or latent myocardial ischemia.

Concerns are also frequently raised regarding the risk of arrhythmias and sudden cardiac death. In a study involving 98 patients with a history of acute myocardial infarction, arrhythmic events were observed in only 8% of participants during sauna bathing, compared with an incidence of 18% during submaximal physical exercise[26]. In the majority of reported cases of sauna-associated sudden cardiac death, alcohol consumption was identified as a contributing factor. Alcohol intake in conjunction with sauna use increases the risk of hypotension, cardiac complications, and accidental injuries[24].

In individuals who have not previously engaged in regular sauna use, unexpected adverse reactions may occur. Therefore, the implementation of specific safety measures is advisable in sauna-naïve individuals, including shorter sauna sessions, longer recovery periods between sessions, adequate fluid replacement, and avoidance of cold-water immersion. Additionally, unsupervised sauna use or sauna bathing without a companion should be discouraged in this population.

Contraindications

Sauna bathing in any form, as well as the use of warm-water baths, is clearly contraindicated in the following conditions[26]:

- unstable angina
- any unstable clinical condition
- severe aortic stenosis
- recent myocardial infarction
- recent transient ischemic attack or stroke
- elderly patients with orthostatic hypotension.

Zaključak

Rekreacija obuhvaća tjelesne i/ili intelektualne aktivnosti koje zadovoljavaju čovjekove temeljne psihološke i biološke potrebe. U fazi rekonvalescencije nakon KV događaja često se postavlja pitanje o mogućnosti sudjelovanja u rekreacijskim aktivnostima. Prethodnih je desetljeća klinička praksa često nepotrebno uskraćivala bolesnicima s KV bolestima mogućnost bavljenja aktivnostima koje su vezane uz putovanja i *wellness*.

Detaljno poznavanje fizioloških i hemodinamskih učinaka korištenja zračnim prijevozom i različitim oblicima pasivne izloženosti toplini omogućuje primjerenu procjenu rizika vezanih uz letenje i *wellness* aktivnosti. Slijedom toga, skupina bolesnika u kojih su navedene aktivnosti kontraindicirane postala je uže definirana, čime je većem broju osoba s KV bolestima omogućeno sigurno sudjelovanje u putovanjima i rekreacijskim sadržajima vezanim uz *wellness* aktivnosti.

Conclusion

Recreation encompasses physical and/or intellectual activities that fulfill fundamental psychological and biological human needs. During the convalescent phase of rehabilitation following a cardiovascular event, questions regarding participation in recreational activities frequently arise. In previous decades, clinical practice often unnecessarily deprived patients with cardiovascular disease of opportunities related to travel and wellness activities.

With a detailed understanding of the physiological and hemodynamic effects associated with air travel and various passive heat modalities, the risks related to flying and wellness activities can be appropriately assessed. As a result, the population of patients for whom these activities are contraindicated has become more narrowly defined, allowing a greater number of individuals with cardiovascular disease to safely benefit from travel and wellness-related recreational opportunities.

LITERATURE

1. Fritz P. Physical recreation. Szeged: Bába; 2011.
2. Révész L, Müller A, Herpainé LJ, Boda E, Bíró M. Theory and methodology of recreation, Vol. 1. Eger: Líceum; 2015.
3. Ruskin KJ. In-flight medical emergencies: time for a registry? Crit Care. 2009;13(1):121. https://doi.org/10.1186/cc7715
4. Sand M, Bechara FG, Sand D, Mann B. Surgical and medical emergencies on board European aircraft: a retrospective study of 10189 cases. Crit Care. 2009;13(1):R3. https://doi.org/10.1186/cc7690
5. Peterson DC, Martin-Gill C, Guyette FX, Tobias AZ, McCarthy CE, Harrington ST, et al. Outcomes of medical emergencies on commercial airline flights. N Engl J Med. 2013 May 30;368(22):2075-83. https://doi.org/10.1056/NEJMoa1212052
6. Kim JH, Choi-Kwon S, Park YH. Comparison of inflight first aid performed by cabin crew members and medical volunteers. J Travel Med. 2017 Mar 1;24(2). https://doi.org/10.1093/jtm/taw091
7. Kesapli M, Akyol C, Gungor F, Akyol AJ, Guven DS, Kaya G. Inflight Emergencies During Eurasian Flights. J Travel Med. 2015 Nov-Dec;22(6):361-7. https://doi.org/10.1111/jtm.12230
8. Martin-Gill C, Doyle TJ, Yealy DM. In-Flight Medical Emergencies: A Review. JAMA. 2018 Dec 25;320(24):2580-2590. https://doi.org/10.1001/jama.2018.19842
9. Koh CH. Commercial Air Travel for Passengers With Cardiovascular Disease: Recommendations for Common Conditions. Curr Probl Cardiol. 2021 Mar;46(3):100768. https://doi.org/10.1016/j.cpcardiol.2020.100768
10. Bettes TN, McKenas DK. Medical advice for commercial air travelers. Am Fam Physician. 1999 Sep 1;60(3):801-8. **PubMed**: https://pubmed.ncbi.nlm.nih.gov/10498108/
11. Aerospace Medical Association Medical Guidelines Task Force. Medical Guidelines for Airline Travel, 2nd ed. Aviat Space Environ Med. 2003 May;74(5 Suppl):A1-19. **PubMed**: https://pubmed.ncbi.nlm.nih.gov/12817610/
12. Smith D, Toff W, Joy M, Dowdall N, Johnston R, Clark L, et al. Fitness to fly for passengers with cardiovascular disease. Heart. 2010 Aug;96 Suppl 2:ii1-16. https://doi.org/10.1136/hrt.2010.203091
13. Possick SE, Barry M. Evaluation and management of the cardiovascular patient embarking on air travel. Ann Intern Med. 2004 Jul 20;141(2):148-54. https://doi.org/10.7326/0003-4819-141-2-200407200-00014
14. Possick SE, Barry M. Air travel and cardiovascular disease. J Travel Med. 2004 Jul-Aug;11(4):243-8. https://doi.org/10.2310/7060.2004.19009
15. Silverman D, Gendreau M. Medical issues associated with commercial flights. Lancet. 2009 Jun 13;373(9680):2067-77. https://doi.org/10.1016/S0140-6736(09)60209-9
16. Simpson C, Dorian P, Gupta A, Hamilton R, Hart S, Hoffmaster B, et al; Canadian Cardiovascular Society Consensus Conference. Assessment of the cardiac patient for fitness to drive: drive subgroup executive summary. Can J Cardiol. 2004 Nov;20(13):1314-20. **PubMed**: https://pubmed.ncbi.nlm.nih.gov/15565193/
17. Hammadah M, Kindya BR, Allard-Ratick MP, Jazbeh S, Eapen D, Wilson Tang WH, et al. Navigating air travel and cardiovascular concerns: Is the sky the limit? Clin Cardiol. 2017 Sep;40(9):660-666. https://doi.org/10.1002/clc.22741
18. Kauppinen K. Sauna, shower, and ice water immersion. Physiological responses to brief exposures to heat, cool, and cold. Part II. Circulation. Arctic Med Res. 1989 Apr;48(2):64-74. **PubMed**: https://pubmed.ncbi.nlm.nih.gov/2736002/
19. Ohori T, Nozawa T, Ihori H, Shida T, Sobajima M, Matsuki A, et al. Effect of repeated sauna treatment on exercise tolerance and endothelial function in patients with chronic heart failure. Am J Cardiol. 2012 Jan 1;109(1):100-4. https://doi.org/10.1016/j.amjcard.2011.08.014
20. Tei C, Horikiri Y, Park JC, Jeong JW, Chang KS, Toyama Y, et al. Acute hemodynamic improvement by thermal vasodilation in congestive heart failure. Circulation. 1995 May 15;91(10):2582-90. https://doi.org/10.1161/01.CIR.91.10.2582
21. Johnson JM, Proppe DW. Cardiovascular Adjustments to Heat Stress. Comprehensive Physiology, 1994: 215-243. https://doi.org/10.1002/j.2040-4603.1994.tb01157.x
22. Brunt VE, Eymann TM, Francisco MA, Howard MJ, Minson CT. Passive heat therapy improves cutaneous microvascular function in sedentary humans via improved nitric oxide-dependent dilation. J Appl Physiol (1985). 2016 Sep 1;121(3):716-23. https://doi.org/10.1152/japplphysiol.00424.2016
23. Laukkanen T, Kunutsor SK, Zaccardi F, Lee E, Willeit P, Khan H, et al. Acute effects of sauna bathing on cardiovascular function. J Hum Hypertens. 2018 Feb;32(2):129-138. https://doi.org/10.1038/s41371-017-0008-z
24. Laukkanen JA, Laukkanen T, Kunutsor SK. Cardiovascular and Other Health Benefits of Sauna Bathing: A Review of the Evidence. Mayo Clin Proc. 2018 Aug;93(8):1111-1121. https://doi.org/10.1016/j.mayocp.2018.04.008
25. Francisco MA, Colbert C, Larson EA, Sieck DC, Halliwill JR, Minson CT. Hemodynamics of post-exercise vs. post hot water immersion recovery. J Appl Physiol (1985). 2021 Feb 25;130(5):1362-72. https://doi.org/10.1152/japplphysiol.00260.2020

26. Brunt VE, Minson CT. Heat therapy: mechanistic underpinnings and applications to cardiovascular health. J Appl Physiol (1985). 2021 Jun 1;130(6):1684-1704. https://doi.org/10.1152/japplphysiol.00141.2020
27. Minson CT, Wladkowski SL, Cardell AF, Pawelczyk JA, Kenney WL. Age alters the cardiovascular response to direct passive heating. J Appl Physiol (1985). 1998 Apr;84(4):1323-32. https://doi.org/10.1152/jappl.1998.84.4.1323
28. Wilson TE, Tollund C, Yoshiga CC, Dawson EA, Nissen P, Secher NH, et al. Effects of heat and cold stress on central vascular pressure relationships during orthostasis in humans. J Physiol. 2007 Nov 15;585(Pt 1):279-85. https://doi.org/10.1113/jphysiol.2007.137901
29. Kukkonen-Harjula K, Kauppinen K. Health effects and risks of sauna bathing. Int J Circumpolar Health. 2006 Jun;65(3):195-205. https://doi.org/10.3402/ijch.v65i3.18102
30. Eisalo A, Luurila OJ. The Finnish sauna and cardiovascular diseases. Ann Clin Res. 1988;20(4):267-70. **PubMed**: https://pubmed.ncbi.nlm.nih.gov/3218899/
31. Keast ML, Adamo KB. The Finnish sauna bath and its use in patients with cardiovascular disease. J Cardiopulm Rehabil. 2000 Jul-Aug;20(4):225-30. https://doi.org/10.1097/00008483-200007000-00002
32. Gayda M, Paillard F, Sosner P, Juneau M, Garzon M, Gonzalez M, et al. Effects of sauna alone and postexercise sauna baths on blood pressure and hemodynamic variables in patients with untreated hypertension. J Clin Hypertens (Greenwich). 2012 Aug;14(8):553-60. https://doi.org/10.1111/j.1751-7176.2012.00637.x
33. Radtke T, Poerschke D, Wilhelm M, Trachsel LD, Tschanz H, Matter F, et al. Acute effects of Finnish sauna and cold-water immersion on haemodynamic variables and autonomic nervous system activity in patients with heart failure. Eur J Prev Cardiol. 2016 Apr;23(6):593-601. https://doi.org/10.1177/2047487315594506