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FIZIČKA AKTIVNOST KOD OSOBA SA HAŠIMOTO TIREOIDITISOM: ZNAČAJ, BARIJERE I SMERNICE ZA TRENING

Sažetak: Hašimoto tireoiditis (HT) predstavlja najčešći uzrok hipotireoze i često je praćen smanjenim funkcionalnim sposobnostima, umorom i narušenim kvalitetom života, čak i kod pacijenata sa regulisanim hormonskim statusom. U poslednje vreme fizička aktivnost se sve više prepoznaje kao važna nefarmakološka strategija u upravljanju ovim stanjem. Cilj ovog rada bio je da prikaže mehanizme delovanja fizičke aktivnosti kod osoba sa HT, identifikuje ključne barijere za njenu primenu i ponudi praktične smernice za planiranje i sprovođenje treninga.

Na osnovu pregleda literature i kliničkog iskustva, identifikovane su fizičke, psihološke, terapijske, organizacione i stručne barijere koje mogu otežati uključivanje u redovnu fizičku aktivnost. Istovremeno, prikazani su potencijalni pozitivni efekti vežbanja na funkciju štitaste žlezde, telesni sastav, kardiorespiratorne sposobnosti i mentalno zdravlje.

Rad naglašava značaj postepenog i individualno prilagođenog pristupa, uz praćenje reakcije na opterećenje i usklađivanje treninga sa terapijom. Kao praktičan model predlaže se kombinacija aerobnih aktivnosti, vežbi snage i intervalnih metoda, uz poseban akcenat na intervalni trening sa varijabilnim intenzitetom kao potencijalno efikasan i bezbedan pristup u ovoj populaciji.

Zaključuje se da fizička aktivnost ima značajan potencijal kao deo sveobuhvatnog pristupa u radu sa osobama sa Hašimoto tireoiditisom, ali da su za njenu širu primenu neophodne jasnije smernice i bolja integracija u kliničku praksu.

Ključne reči: autoimuni tireoiditis, hipotireoza, intolerancija na vežbanja, umor, psihosocijalno stanje, zdravstveno usmeren trening.

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1. Uvod

Hašimoto tireoiditis je hronično autoimuno oboljenje štitaste žlezde i najčešći je uzrok nastanka hipotiroidizma i karakteriše se povećanom proizvodnjom specifičnih antitela koja uništavaju tiroidne ćelije, što može dovesti do pada u proizvodnji tiroidnih hormona [1] [2].

Bolest se razvija kroz više faza – u početku može trajati godinama bez simptoma, zatim se javljaju antitela, a kasnije i poremećaji hormona (najpre povišen tireostimulirajući hormon – TSH, a potom pad trijodotrionina – T3 i tiroksina – T4).

Važno je naglasiti da simptomi mogu da se jave i u ranim fazama, iako su hormoni još u granicama normale. Spektar simptoma je širok i uključuje umor, manjak energije, pospanost, loš san, pad koncentracije, promene raspoloženja, anksioznost ili depresivnost, opadanje kose, suvu kožu, otoke, sklonost gojenju, ali i probavne smetnje, kao i pojavu anemije. Kako bolest napreduje i funkcija štitaste žlezde opada simptomi postaju izraženiji i intenzivniji, a fizička sposobnost se dodatno smanjuje [1].

Adekvatna primena terapije dovodi rad štitaste žlezde u eutiroidno stanje [3] [4]. Međutim, čak i nakon primene terapije veliki broj pacijenata i dalje oseća izražene simptome, ima smanjen kvalitet života, narušen lipidni profil i slabije funkcionalne sposobnosti [5]. U zavisnosti od studije, pokazalo se da, nakon primene levotiroksina i normalizacije nivoa TSH, od 10 do čak 50% pacijenata i dalje prijavljuje simptome [2, 6].

U ovom kontekstu, faktori načina života koji se mogu menjati sve više se prepoznaju kao značajni činioci u ispoljavanju i napredovanju bolesti. Uticaji iz okruženja i obrasci ponašanja mogu delovati i na funkciju štitaste žlezde i na autoimune procese, pri čemu njihova korekcija može doprineti povoljnijim kliničkim ishodima [7].

Fizička aktivnost se izdvaja kao jedan od najvažnijih primenljivih promena u životnom stilu kod autoimunih oboljenja štitaste žlezde. Dostupni dokazi ukazuju da redovno i umereno vežbanje može imati pozitivan efekat na funkciju štitaste žlezde, uključujući snižavanje nivoa TSH i povećanje koncentracije T4 [8]. Pored toga, fizička aktivnost pozitivno doprinosi smanjenju simptoma, unapređenju funkcionalnog kapaciteta, kao i mentalnog stanja i kvaliteta života kod osoba sa HT [5].

Uprkos sve većem broju dokaza, fizička aktivnost i dalje nije sistematski integrisana u standardni tretman pacijenata sa Hašimotovim tireoiditisom. Dosadašnja istraživanja nedovoljno su se bavila identifikacijom prepreka koje otežavaju njenu primenu u ovoj populaciji. Istovremeno, iako skorašnje studije [8, 9] ukazuju na potencijalne pozitivne efekte posebno strukturisanih programa vežbanja na funkciju štitaste žlezde i druge zdravstvene ishode, zvanične preporuke za planiranje i vođenje trenažnog procesa kod ovih pacijenata i dalje ne postoje.

Cilj ovog rada da razmotri mehanizme putem kojih fizička aktivnost može uticati na kliničke ishode kod osoba sa Hašimotovim tireoiditisom, kao i da, oslanjajući se na savremene naučne dokaze i kliničko iskustvo, identifikuje ključne barijere u njenoj primeni i predloži praktične strategije i osnovne smernice za implementaciju i vođenje trenažnog programa.

2. Klinička slika Hašimoto tireoiditisa

Postoje tri osnovna oblika Hašimoto tireoiditisa (HT): eutiroidni, subkliničk i klinički. Eutiroidni oblik karakteriše prisustvo povišenih antitela (antiTPO i antiTG), uz očuvane vrednosti tiroidnih hormona, dok se kod subkliničkog beleži porast TSH, uz uredne T3 i T4. Klinički oblik obeležava dalji porast TSH i pad tiroidnih hormona, što je praćeno izraženim simptomima i zahteva supstitucionu terapiju [1].

Osnovu patofiziologije HT čini hronična autoimuna reakcija praćena niskostepenim sistemskim zapaljenjem, prisutnim u svim fazama bolesti. Ovaj proces može dovesti do širokog spektra opštih simptoma, uključujući umor, smanjenu energiju, poremećaj sna, promene telesne mase, suvu kožu, opadanje kose, edeme, konstipaciju, bradikardiju, mišićne grčeve, bolove u zglobovima, kao i kognitivne smetnje i depresivnost [1]. Prisustvo i kombinacija ovih simptoma značajno narušavaju kvalitet života obolelih [10, 11].

Kod osoba sa HT često se beleže poremećaji lipidnog profila, uključujući povišene vrednosti triglicerida, ukupnog i LDL holesterola, uz snižene vrednosti HDL holesterola [12, 13]]. Pored toga, autoimuni proces povezan je sa oštećenjem endotelne funkcije, što dodatno povećava rizik od ateroskleroze i kardiovaskularnih komplikacija [14].

Smanjena funkcija štitaste žlezde ima značajne posledice na mišićni i kardiovaskularni sistem. Tiroidni hormoni učestvuju u regulaciji kontraktilnosti skeletnog i srčanog mišića, pa njihov deficit dovodi do smanjenja mišićne snage, udarnog i minutnog volumena srca, uz povećanje perifernog vaskularnog otpora i smanjenje srčane i plućne rezerve [15]. Kao posledica dolazi do opadanja kardiorespiratornih sposobnosti, uključujući smanjenu maksimalnu potrošnju kiseonika (VO_2max) i toleranciju na napor, posebno pri višim intenzitetima [16, 17].

Pored hormonskog disbalansa, i sam autoimuni proces može doprineti smanjenju funkcionalnih sposobnosti i povećanom osećaju umora, čak i kod eutiroidnih pacijenata. Tako su Jordan i sar. (2021) pokazali da eutiroidni pacijenti sa HT tokom šestominutnog testa hodanja ispoljavaju izraženiji fizički umor, veću percepciju zamora i bolova u mišićima u poređenju sa zdravim ispitanicima, uprkos urednim neurološkim i elektrofiziološkim nalazima [18].

3. Značaj fizičke aktivnosti kod Hašimoto tireoiditisa

Fizička aktivnost se sve više prepoznaje kao važna nefarmakološka strategija kod pacijenata sa HT. Skorašnje studije ukazuju na potencijalne pozitivne efekte vežbanja na funkciju štitaste žlezde, uključujući smanjenje nivoa TSH i povećanje koncentracija slobodnog tiroksina (FT4) [5, 19, 20]. Ovi efekti mogu se delimično objasniti stimulacijom hipotalamo-hipofizno-tiroidne ose [21], kao i povećanom aktivnošću dejodinaza na perifernom nivou, što doprinosi efikasnijoj konverziji T4 u biološki aktivniji T3 [22]. Takođe, povećana metabolička potražnja tokom fizičke aktivnosti može stimulisati veću upotrebu i promet tiroidnih hormona, što sekundarno utiče na regulaciju TSH [23].

Pored hormonskih efekata, fizička aktivnost ima značajnu ulogu u regulaciji telesnog sastava, što je posebno važno kod osoba sa HT. Smanjenje ukupne i visceralne masne mase, koje su metabolički aktivne i proinflamatorne, može doprineti redukciji sistemske inflamacije karakteristične za ovu bolest [24]. S obzirom na to da je hronična niskostepena inflamacija jedan od ključnih patofizioloških mehanizama HT, ovaj efekat vežbanja predstavlja važan potencijalni put ka poboljšanju kliničkog statusa. Studije su takođe pokazale smanjenje inflamatornih markera, poput C-reaktivnog proteina (CRP), kao i poboljšanje endotelne funkcije nakon dugotrajnijih programa vežbanja [14, 25].

Na nivou kardiovaskularnog i mišićnog sistema, fizička aktivnost doprinosi poboljšanju kontraktilnosti srčanog i skeletnog mišića, povećanju udarnog i minutnog volumena, kao i efikasnijoj perifernoj distribuciji kiseonika. Ovi efekti su praćeni povećanjem VO_2max i ukupne kardiorespiratorne izdržljivosti [26, 27] . Mehanizmi koji stoje u osnovi ovih promena uključuju poboljšanu oksigenizaciju tkiva, povećanu kapilarnu gustinu, ali i potencijalnu modulaciju ekspresije tiroidnih receptora i lokalne aktivnosti dejodinaza u mišićnom tkivu [22] . Važno je naglasiti da su poboljšanja funkcionalnih sposobnosti zabeležena čak i u odsustvu značajnih promena telesne mase [14, 25], što ukazuje na direktne efekte vežbanja na kardiovaskularni sistem.

Fizička aktivnost takođe ima izražene efekte na psihološke aspekte bolesti i kvalitet života. Redovno vežbanje doprinosi smanjenju simptoma depresije, anksioznosti, stresa, kao i kvaliteta sna [28], što se može objasniti povećanim lučenjem neurotransmitera i hormona povezanih sa regulacijom raspoloženja, poput serotonina, dopamina i endorfina [29]. Studije su pokazale značajna poboljšanja u domenima fizičkog i mentalnog zdravlja, vitalnosti i socijalnog funkcionisanja kod osoba koje su učestvovale u programima vežbanja [5, 10]. S obzirom na to da simptomi poput umora, smanjene energije i kognitivnih poteškoća često perzistiraju i kod eutiroidnih pacijenata, ovi efekti imaju poseban klinički značaj.

4. Barijere za primenu fizičke aktivnosti kod Hašimoto tireoiditisa

Iako naučna saznanja podržavaju primenu fizičke aktivnosti kod Hašimoto tireoiditisa ona još uvek nije dovoljno prepoznata i implementirana u radu sa ovim pacijentima. Na osnovu pregleda naučne literature i kliničkog iskustva u radu sa ovim pacijentima barijere za primenu fizičke aktivnosti možemo podeliti u nekoliko kategorija, a to su: fizičke barijere usled simptoma, psihološke, barijere usled neadekvatno podešene terapije, barijere povezane sa savremenim načinom života i nedostatkom organizacije vremena i barijere u stručnom pristupu i implementaciji vežbanja**.**

4.1. Fizičke barijere usled simptoma

Kod osoba sa Hašimotovim tireoiditisom i hipotireozom, čak i uz adekvatnu hormonsku terapiju, često postoji kombinacija objektivno smanjene tolerancije napora i subjektivnog osećaja hroničnog nedostatka energije, što značajno otežava uvođenje i održavanje redovne fizičke aktivnosti [1]. Ipak, nalazi intervencionih studija ukazuju da adekvatno dozirana, strukturisana aerobna ili kombinovana fizička aktivnost može dovesti do poboljšanja funkcionalnog kapaciteta, raspoloženja i kvaliteta života [9].

Umor, nedostatak energije i subjektivna slabost nalaze se među najčešće prijavljivanim simptomima koji umanjuju motivaciju i spremnost za uključivanje u strukturisane programe vežbanja, naročito kod nelečenih ili suboptimalno lečenih pacijenata [30]. Ove tegobe nisu isključivo subjektivne prirode, već su često praćene i merljivim padom performansi. Na primer, kod eutireoidnih pacijenata sa Hašimotom pokazano je da tokom 6-minutnog testa hoda dolazi do progresivnog opadanja performansi (negativan linearni trend), uz višu percepciju zamora i bolova u mišićima u poređenju sa zdravim kontrolama [18].

Dodatno, kod osoba sa subkliničkom hipotireozom zabeleženi su sniženi maksimalni radni učinak i VO_2max, uz brže nakupljanje laktata, veći porast piruvata i veću oslonjenost na anaerobni metabolizam pri rastu opterećenja. Ovakav metabolički profil praktično se manifestuje kao smanjena tolerancija na intenzivnije oblike fizičke aktivnosti, naročito u zoni anaerobnog praga i iznad [17, 31] .

Na subjektivnom nivou, anketne studije pokazuju da približno dve trećine žena sa hipotireozom na supstitucionoj terapiji doživljava da im bolest ograničava fizičku aktivnost, pri čemu su ograničenja izraženija kod autoimunog, Hašimotovog oblika. Najčešće prijavljene smetnje uključuju mišićni bol, izražen zamor nakon vežbanja, produžen oporavak i nesigurnost u sopstvene fizičke kapacitete [30, 32].

4.2. Psihološke barijere

Kod osoba sa HT česte su psihološke smetnje, uključujući depresivno raspoloženje, anksioznost, kognitivne tegobe i perzistentni umor, koje mogu značajno smanjiti

motivaciju i spremnost za uključivanje u redovnu fizičku aktivnost [33]. Važno je naglasiti da ove smetnje nisu nužno isključivo posledica hormonskog disbalansa, već mogu biti prisutne i kod eutireoidnih pacijenata. Naime, pokazano je da osobe sa HT, uprkos urednim hormonskim vrednostima, imaju više skorove depresije i anksioznosti, kao i lošiji mentalni domen kvaliteta života u odnosu na zdrave kontrole, što ukazuje na potencijalni uticaj same autoimunosti na psihičko stanje i subjektivni doživljaj zdravlja [34].

Ovi nalazi su dodatno potvrđeni metaanalizama koje ukazuju da autoimuni tireoiditis nosi približno 2–3 puta veći rizik za razvoj depresivnih i anksioznih poremećaja [35], što posledično može dovesti do smanjene inicijative, nižeg nivoa energije i izbegavanja napora. Ove promene, zajedno sa prisutnim kognitivnim smetnjama, narušavaju svakodnevno funkcionisanje i kvalitet života pacijenata [36], a time indirektno otežavaju usvajanje i održavanje fizičke aktivnosti kao dela svakodnevne rutine.

Dodatno, kod žena sa HT uočava se viši nivo psihološkog distresa i somatizacije, dok su određeni afektivni temperamenti (npr. depresivni i ciklotimni) povezani sa većim intenzitetom psihosomatskih tegoba [37]. Ovakav obrazac može pojačati subjektivni doživljaj umora, bola i opterećenosti, zbog čega se i umereni fizički napor često percipira kao preteći ili prekomeran.

Ipak, ove barijere nisu nepromenljive. Istraživanja pokazuju da psihoterapijski pristupi, posebno kognitivno-bihejvioralna terapija, mogu dovesti do smanjenja stresa i depresivnosti, kao i do poboljšanja kvaliteta života kod ovih pacijenata [38], što potencijalno smanjuje otpor ka fizičkoj aktivnosti. U tom kontekstu, kombinacija psihološke podrške i postepenog, individualno prilagođenog uvođenja fizičke aktivnosti može imati sinergijski efekat.

U praktičnom smislu, to znači da su psihološke barijere kod osoba sa HT realne i klinički relevantne, ali nisu nepremostive. Uz adekvatnu podršku i pažljivo dozirano uključivanje u fizičku aktivnost, mnogi pacijenti mogu relativno brzo ući u pozitivan ciklus, koji podrazumeva povećanje nivoa kretanja, poboljšanje raspoloženja, porast energije i unapređenje ukupne funkcionalnosti [8, 38].

4.3. Barijere usled neadekvatno podešene terapije

Na osnovu više studija iz primarne zdravstvene zaštite i ambulantnih populacija, može se konstatovati da se otprilike 30–50% lečenih hipotireotičnih pacijenata nalazi van ciljnog TSH opsega, tj. da im je terapija suboptimalno podešena [39, 40].

Neadekvatno lečenje hipotireoze povezano je sa smanjenim minutnim volumenom srca, mišićnom slabošću i oslabljenom funkcijom pluća, što zajedno dovodi do smanjenog fizičkog kapaciteta i tolerancije na napor. Ove promene dodatno doprinose umoru, smanjenoj funkcionalnoj sposobnosti i opštem padu kvaliteta života [41].

S druge strane, prekomerna supstitucija tireoidnih hormona može dovesti do mišićne disfunkcije, povećanog metaboličkog opterećenja i kardiovaskularne nestabilnosti, uključujući aritmije, što negativno utiče na izvođenje i oporavak tokom vežbanja. Takođe, prekomerna supstitucija je povezana sa smanjenom fizičkom funkcionalnošću i ukupnim padom kapaciteta za fizičku aktivnost uprkos povećanoj metaboličkoj aktivnosti [41].

4.4. Barijere povezane sa savremenim načinom života i nedostatkom organizacije vremena

Barijere povezane sa savremenim načinom života i nedostatkom organizacije vremena predstavljaju značajan faktor koji otežava primenu fizičke aktivnosti. U tom kontekstu, podaci ukazuju da čak i kod osoba sa lečenom hipotireozom nivo fizičke aktivnosti ostaje nizak, pri čemu je u velikoj studiji na 1.724 žene samo 16,1% ispitanica ispunjavalo preporuke za fizičku aktivnost [32]. Istraživanja u opštoj populaciji i kod osoba sa hroničnim bolestima ukazuju da su nedostatak vremena, radne obaveze, briga o drugima, umor i stres među najčešće prijavljenim preprekama za redovno vežbanje [42, 43]. Ovi faktori su često povezani sa savremenim obrascima života, koji podrazumevaju sedentaran stil, visok nivo psihološkog opterećenja i otežanu integraciju fizičke aktivnosti u svakodnevne rutine [43]. Iako ne postoje studije koje direktno ispituju ove organizacione barijere kod osoba sa HT, može se pretpostaviti da se sličan obrazac javlja i u ovoj populaciji, što potvrđuje i kliničko iskustvo u radu sa ovim pacijentima. Dodatno, prisustvo hroničnog umora i smanjene energije može još više otežati organizaciju svakodnevnih aktivnosti i integraciju fizičke aktivnosti u svakodnevni život.

4.5. Barijere u stručnom pristupu i implementaciji vežbanja

Značajnu prepreku implementaciji fizičke aktivnosti kod osoba sa HT predstavljaju i sistemske barijere, koje su dobro opisane i u širem kontekstu hroničnih nezaraznih bolesti. Pre svega, uočava se nedovoljna saradnja između zdravstvenog sistema i stručnjaka koji sprovode zdravstveno usmereno vežbanje, uključujući trenere i profesore fizičkog vaspitanja, što dovodi do fragmentisanog pristupa i izostanka individualizovanih preporuka za pacijente [44, 45]. Pored toga, prisutan je i nedostatak edukovanih stručnjaka osposobljenih za rad sa ovom populacijom, kao i ograničen broj edukacija koje se specifično bave integracijom medicinskih i trenažnih principa u radu sa osobama sa hroničnim nezaraznim bolestima [44, 45]. Dodatni problem predstavlja odsustvo zvaničnih smernica koje bi jasno definisale vrstu, intenzitet i obim fizičke aktivnosti [46, 47]. Iako savremena naučna saznanja sve više ukazuju na potencijalne benefite fizičke aktivnosti u ovoj populaciji, nedostatak standardizovanih preporuka otežava njihovu praktičnu primenu i ostavlja prostor za nesigurnost, kako kod stručnjaka tako i kod samih pacijenata [47].

5. Preporuke za primenu fizičke aktivnosti kod pacijenata sa Hašimoto tireoiditisom

5.1. Procena trenutnog stanja pacijenta sa HT pre započinjanja specifičnog programa vežbanja

Pre uključivanja osobe sa HT u program vežbanja neophodno je sprovesti inicijalnu procenu njenog zdravstvenog i funkcionalnog statusa. Ova procena predstavlja osnov za planiranje individualizovanog programa vežbanja i izbor odgovarajuće vrste, intenziteta i obima fizičke aktivnosti [48].

Međutim, kod osoba sa HT važno je imati u vidu da se simptomi i subjektivni osećaj spremnosti mogu značajno menjati iz dana u dan, pa čak i tokom dana. Fluktuacije u nivou energije, prisustvu umora, raspoloženju i opštoj fizičkoj spremnosti mogu biti posledica hormonskih varijacija, stresa, kvaliteta sna ili neadekvatno podešene terapije [1]. Zbog toga je pre svakog treninga preporučljivo izvršiti kratku procenu trenutnog stanja pacijenta, koja može obuhvatiti razgovor o prisutnim simptomima, procenu subjektivnog osećaja opterećenja i spremnosti za vežbanje, a po potrebi i jednostavne objektivne pokazatelje, poput srčane frekvencije ili arterijskog pritiska [49].

U tom kontekstu, plan i program vežbanja ne bi trebalo sprovoditi rigidno, već ga po potrebi prilagođavati trenutnom subjektivnom i objektivnom stanju pacijenta. Individualizacija i fleksibilno prilagođavanje opterećenja u skladu sa dnevnim varijacijama predstavljaju jedan od osnovnih principa bezbedne i efikasne primene fizičke aktivnosti kod osoba sa HT [50].

5.2. Planiranje i periodizacija trenažnog programa vežbanja

Početne informacije koje trener (sportski stručnjak) dobije od pacijenta treba da posluže za što preciznije planiranje i periodizaciju trenažnog opterećenja. Ključni aspekti koje je neophodno evaluirati uključuju trenutno subjektivno i objektivno stanje pacijenta, skorašnje laboratorijske nalaze (posebno nivo TSH), prethodni nivo treniranosti, kao i trenutni nivo fizičke spreme. Fizička spremnost se može proceniti jednostavnim i praktično primenljivim testovima, kao što su testovi kardiorespiratorne funkcije (npr. step test ili test na biciklu sa kontrolom opterećenja), kao i indirektni testovi mišićne snage (npr. broj ponavljanja čučnjeva, sklekova ili izdržaj u planku) [51, 52].

Važnu varijablu predstavlja i maksimalna srčana frekvencija (HRmax), na osnovu koje se mogu definisati zone intenziteta. Uopšteno, opterećenja ispod ~80% HRmax pripadaju pretežno aerobnoj zoni, dok viši intenziteti uključuju značajniji anaerobni doprinos, iako je u praksi moguće razlikovati više trenažnih zona [53] [40]. Na osnovu ovih parametara, trening treba planirati u skladu sa principima sistematičnosti i

postupnosti, uz progresivno povećanje opterećenja, prelazak od jednostavnijih ka složenijim vežbama i obezbeđivanje adekvatnog vremena za oporavak.

Periodizacija trenažnog procesa treba da uvaži i dnevne i nedeljne fluktuacije u stanju pacijenta. Intenzivniji mikrociklusi mogu se planirati u periodima kada se pacijent oseća odmorno, ima više energije i bolje raspoloženje, dok se u fazama izraženijeg umora preporučuju rasterećujući ili oporavljajući mikrociklusi. Ovakav fleksibilan i individualizovan pristup omogućava postepeno uvođenje u trenažni proces, smanjuje rizik od preopterećenja i negativnih efekata, te povećava verovatnoću dugoročnog pridržavanja trenažnog programa vežbanja i ispoljavanja pozitivnih zdravstvenih efekata [50, 54] [41, 42].

5.3. Praćenje opterećenja i odgovora na trening

Tokom treninga preporučuje se kontinuirano praćenje kako subjektivnih, tako i objektivnih pokazatelja intenziteta i opterećenja. Osnovni objektivni pokazatelj predstavlja srčana frekvencija, na osnovu koje se može proceniti zona intenziteta u kojoj pacijent vežba, ali i njegova sposobnost oporavka, s obzirom na to da brzina opadanja srčane frekvencije nakon opterećenja predstavlja važan indikator utreniranosti i tolerancije na napor [55] [43].

Posebnu pažnju potrebno je obratiti kod pacijenata sa nedovoljno regulisanom hipotireozom i povišenim nivoima TSH, kod kojih može biti prisutna bradikardija, što otežava dostizanje viših vrednosti srčane frekvencije uprkos subjektivno visokom naporu [41] [37]. U takvim situacijama neophodno je izbegavati forsiranje pacijenta i oslanjati se i na druge pokazatelje intenziteta. S druge strane, kod pacijenata sa prekomernom dozom terapije može doći do nesrazmerno visokog porasta srčane frekvencije i pri nižim opterećenjima, što zahteva dodatni oprez i ograničavanje intenziteta treninga [41] [37].

Zbog navedenih specifičnosti, praćenje subjektivnog doživljaja napora ima poseban značaj. U tu svrhu mogu se koristiti standardizovane skale procene napora, kao što je Borgova RPE skala [56] [44], ali i neposredna komunikacija sa pacijentom kroz jednostavna pitanja o osećaju zamora, disanju i opštem doživljaju napora. Pored toga, važno je pratiti i reakciju organizma u periodu oporavka nakon treninga, uključujući subjektivni osećaj sledećeg dana. Dodatna korisna strategija jeste da pacijent izvesti o svom stanju nakon treninga, čime se omogućava bolje razumevanje individualne reakcije na opterećenje i dalja optimizacija trenažnog procesa [57].

5.4. Usklađivanje treninga sa terapijom i interdisciplinarna saradnja

Usklađivanje trenažnog procesatreninga sa terapijom predstavlja jedan od ključnih aspekata bezbedne i efikasne primene fizičke aktivnosti kod osoba sa HT. Poseban izazov predstavljaju pacijenti kod kojih stabilna supstituciona terapija još

uvek nije uspostavljena, što je najčešće slučaj u početnim fazama lečenja, kada organizam prolazi kroz proces adaptacije na terapiju [17]. Dodatni oprez je neophodan u situacijama kada se sa uvođenjem terapije i započinjanjem trenažnog procesa kreće istovremeno. U tim slučajevima, na osnovu kliničkog iskustva, možemo preporučiti postepen i konzervativan pristup, uz odlaganje značajnijeg povećanja intenziteta treninga do postizanja relativne stabilizacije hormonskog statusa [17].

Upravo u ovom kontekstu dolazi do izražaja značaj interdisciplinarne saradnje između trenera i endokrinologa. Dvosmerna komunikacija omogućava optimalno usklađivanje doze terapije i opterećenja treninga, čime se smanjuje rizik od neželjenih efekata i povećava efikasnost intervencije [32] [17] [29]. Povratne informacije trenera o simptomima, nivou energije i toleranciji na napor mogu biti od posebnog značaja za endokrinologa prilikom procene adekvatnosti terapijske doze. Ova saradnja treba da bude kontinuirana, imajući u vidu da tokom trenažnog treninga procesa može doći do značajnih promena u telesnom sastavu, metabolizmu i funkcionalnim sposobnostima pacijenta [9] [26].

Sa druge strane, neadekvatno dozirano trenažno opterećenje može dovesti do negativnih efekata, uključujući povećan umor i simptome preopterećenja [58] [45], što dodatno naglašava potrebu za pažljivim praćenjem i pravovremenom komunikacijom sa lekarom. Važno je naglasiti da Hašimoto tireoiditis sam po sebi ne predstavlja kontraindikaciju za fizičku aktivnost, te da većina pacijenata može bezbedno da vežba uz adekvatno vođen program [9] [26]. Ipak, s obzirom na sistemsku prirodu bolesti, kod manjeg broja pacijenata mogu biti prisutne i dodatne zdravstvene smetnje, uključujući kardiovaskularne [59] [46], zbog čega se u pojedinim slučajevima preporučuje dodatna procena od strane kardiologa ili specijaliste sportske medicine pre započinjanja treninga.

5.5. Preporučeni načini vežbanja i oblici fizičke aktivnosti

Kao što je već naglašeno, sa primenom fizičke aktivnosti potrebno je započeti postepeno, od lakših ka zahtevnijim oblicima, uz progresivno povećanje obima i intenziteta treninga. U početnim fazama prednost imaju aerobni oblici aktivnosti, kao što su pešačenje, plivanje, planinarenje, vožnja bicikla, rolera ili ples. S obzirom na često prisutan povišen nivo stresa kod osoba sa HT, važan deo programa treba da obuhvati i aktivnosti usmerene na relaksaciju, poput vežbi disanja, istezanja, joge, tai či i sličnih oblika vežbanja [60] [47].

Nedeljni obim fizičke aktivnosti treba uskladiti sa opštim preporukama, ali i sa individualnim mogućnostima pacijenta. U tom smislu, preporučuje se ukupno 150–300 minuta umereno intenzivne aktivnosti nedeljno, što se u praksi može realizovati na različite načine, na primer kroz 3 treninga nedeljno u trajanju od 45–60 minuta, ili češće svakodnevne, i kraće aktivnosti [61] [48]. Kada je u pitanju pešačenje, to

okvirno odgovara nivou od 7.000–10.000 koraka dnevno ili približno 5–7 km hoda, raspoređenih tokom nedelje [62] [49].

Pored aktivnosti umerenog intenziteta, preporučuje se i uvođenje aktivnosti većeg intenziteta u manjem obimu, na primer 2–3 puta nedeljno, u skladu sa trenutnim stanjem i tolerancijom na napor [61] [48]. Ovo je posebno važno imajući u vidu da osobe sa HT često imaju smanjenu kardiorespiratornu sposobnost i niži nivo mišićne snage [61] [48]..

U skladu sa tim, važan deo programa čine i vežbe snage, koje se takođe preporučuju 2–3 puta nedeljno [63] [50]. U početnim fazama to mogu biti vežbe sa sopstvenom težinom, dok se kasnije uvode dodatna opterećenja (bučice, girje, elastične trake, šipka) [27] [23]. Opterećenje se može dozirati kroz broj ponavljanja, pri čemu se za lakša opterećenja preporučuje 15–20 ponavljanja, a za veća opterećenja 8–12 ponavljanja po seriji [27] [23].

U cilju unapređenja kardiorespiratorne funkcije, mogu se primenjivati i treninzi većeg intenziteta, uključujući kombinovane oblike rada (aerobni trening na spravama, uz vežbe snage) [5][3], ali i intervalni treninzi visokog intenziteta (HIIT) [64] [51]. Ipak, HIIT može biti zahtevan za deo pacijenata zbog naglih prelaza iz stanja odmora u stanje maksimalnog napora i ograničenog vremena za oporavak između intervalaintervala [64] [51].

Zbog toga kao praktičniju i bezbedniju alternativalternativu predlažemo a preporučujemo našu inovativnu metodu u vidu intervalnog treninga sa varijabilnim intenzitetom (VIIT), koji podrazumeva smenjivanje vežbi različitog intenziteta uz pauze. Konkretno, nakon vežbe višeg intenziteta sledi pauza, zatim vežba nižeg intenziteta, pa ponovo pauza (npr. dinamičan skip – pauza – spor, kontrolisan čučanj – pauza). Na taj način omogućava se rad većim intenzitetom uz dovoljno vremena za oporavak, ali i povećanje ukupnog obima aktivnosti, jer ovakav tip treninga može trajati duže. Dodatno, dinamična promena intenziteta i tipa vežbi često se doživljava kao zanimljivija i subjektivno manje naporna [65] protokoli vežbanja pozitivne ishode u prethodnim studijama, a naredna istraživanja bi trebalo da ispitaju ovakvog tipa efekta specifično kod pacijenata sa HT [65] . Slični protokoli vežbanja pokazali su pozitivne efekte i u drugim populacijama [65]. Još značajnije, naša nedavno objavljena studija, u kojoj je VIIT primenjen kod žena sa Hašimotovim tireoiditisom, pokazala je poboljšanje kardiorespiratorne sposobnosti, telesnog sastava i više domena kvaliteta života, uz značajno smanjenje nivoa TSH kod žena sa subkliničkim HT [66].

Bez obzira na tip treninga, preporučuje se da se svaka sesija završi vežbama istezanja i relaksacije [60]. Na kraju, važno je još jednom naglasiti da fizičku aktivnost uvek treba individualno prilagoditi stanju pacijenta i njegovim preferencijama, što predstavlja ključni preduslov za dugoročno pridržavanje programa i postizanje željenih efekata [48].

6. Zaključak

Hašimoto tireoiditis je kompleksno stanje koje, pored hormonskog disbalansa, obuhvata i niz funkcionalnih i psiholoških promena koje mogu otežati primenu fizičke aktivnosti. Iako postoje brojne barijere, dostupni dokazi i kliničko iskustvo ukazuju da pravilno dozirana i individualno prilagođena fizička aktivnost može značajno unaprediti funkcionalne sposobnosti, kvalitet života i opšte zdravstveno stanje ovih pacijenata.

Ključ uspešne primene je u postepenom uvođenju, individualizaciji programa, praćenju reakcije na opterećenje i usklađivanju treninga sa terapijom. Poseban značaj imaju kombinovani oblici treninga, koji uključuju aerobne aktivnosti, vežbe snage i kontrolisane intervalne metode.

I pored rastućeg broja dokaza, fizička aktivnost još uvek nije dovoljno integrisana u standardni pristup lečenju, a nedostatak jasnih smernica otežava njenu primenu. Zbog toga je neophodno dalje povezivanje naučnih saznanja i praktične primene, kako bi fizička aktivnost postala sastavni deo terapijskog pristupa kod osoba sa Hašimoto tireoiditisom.

Etička dozvola: Ovaj rad je deskriptivnog tipa, te odobrenje etičkog komiteta nije bilo potrebno.

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PHYSICAL ACTIVITY IN INDIVIDUALS WITH HASHIMOTO'S THYROIDITIS: IMPORTANCE, BARRIERS, AND EXERCISE GUIDELINES

Abstract: Hashimoto's thyroiditis is the most common cause of hypothyroidism and is frequently associated with reduced functional capacity, fatigue, and impaired quality of life, even in patients with well-controlled thyroid hormone status. In recent years, physical activity has increasingly been recognized as an important non-pharmacological strategy in the management of this condition. The aim of this paper was to describe the mechanisms through which physical activity may exert beneficial effects in individuals with HT, identify the key barriers to its implementation, and provide practical guidelines for exercise planning and prescription.

Based on a review of the available literature and clinical experience, several physical, psychological, treatment-related, organizational, and professional barriers that may hinder participation in regular physical activity were identified. At the same time, the potential beneficial effects of exercise on thyroid function, body composition, cardiorespiratory fitness, and mental health were considered.

This paper emphasizes the importance of a gradual and individualized approach, including monitoring individual responses to exercise and coordinating exercise with medical treatment. A combination of aerobic exercise, resistance training, and interval-based exercise is proposed as a practical model, with particular emphasis on variable-intensity interval training as a potentially effective and safe approach for this population.

In conclusion, physical activity has considerable potential as an integral component of a comprehensive approach to the management of individuals with Hashimoto's thyroiditis. However, clearer exercise guidelines and better integration of physical activity into clinical practice are needed to facilitate its broader implementation.

Keywords: autoimmune thyroiditis, hypothyroidism, exercise intolerance, fatigue, psychosocial well-being, health-oriented exercise

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1. Introduction

Hashimoto's thyroiditis (HT) is a chronic autoimmune disease of the thyroid gland and the most common cause of hypothyroidism. It is characterized by increased production of specific autoantibodies that target and progressively damage thyroid cells, potentially leading to reduced thyroid hormone production [1, 2].

The disease progresses through several stages. In its early stage, it may remain asymptomatic for years, followed by the development of thyroid autoantibodies and, subsequently, alterations in thyroid hormone status. These changes are typically characterized initially by an increase in thyroid-stimulating hormone (TSH), followed by reductions in triiodothyronine (T3) and thyroxine (T4) levels as the disease progresses to the clinical stage [1].

Importantly, symptoms may occur even during the early stages of the disease, while thyroid hormone levels remain within the reference range. The clinical presentation is heterogeneous and may include fatigue, low energy levels, daytime sleepiness, poor sleep quality, impaired concentration, mood disturbances, anxiety or depressive symptoms, hair loss, dry skin, edema, a tendency toward weight gain, gastrointestinal disturbances, and anemia. As the disease progresses and thyroid function declines, symptoms may become more pronounced and functional capacity may deteriorate further [1].

Appropriate pharmacological treatment can restore a euthyroid state [3]. However, even after treatment, a substantial proportion of patients continue to experience persistent symptoms, impaired quality of life, an unfavorable lipid profile, and reduced functional capacity [5]. Depending on the study, approximately 10% to as many as 50% of patients continue to report symptoms despite levothyroxine treatment and normalization of TSH levels [2, 6].

In this context, modifiable lifestyle factors are increasingly recognized as important contributors to disease manifestation and progression. Environmental exposures and behavioral patterns may influence both thyroid function and autoimmune processes, and their modification may therefore contribute to more favorable clinical outcomes [7].

Physical activity represents one of the most important modifiable lifestyle factors in individuals with autoimmune thyroid disease. Available evidence suggests that regular, moderate exercise may exert beneficial effects on thyroid function, including reductions in TSH levels and increases in T4 concentrations [8]. In addition, physical activity may contribute to symptom reduction and improvements in functional capacity, mental health, and quality of life in individuals with HT [5].

Despite the growing body of evidence, physical activity has not yet been systematically integrated into the standard management of patients with HT. Previous research has paid insufficient attention to identifying the barriers that may hinder participation in physical activity in this population. At the same time, although re-

cent studies [8, 9] have demonstrated the potential beneficial effects of specifically structured exercise programs on thyroid function and other health-related outcomes, official recommendations for exercise prescription and the implementation of structured exercise programs in these patients are still lacking.

Therefore, the aim of this paper was to examine the mechanisms through which physical activity may influence clinical outcomes in individuals with HT and, based on current scientific evidence and clinical experience, to identify the key barriers to its implementation and propose practical strategies and fundamental guidelines for the planning and implementation of structured exercise programs.

2. Clinical Presentation of Hashimoto's Thyroiditis

HT can be broadly classified into three main forms: euthyroid, subclinical, and clinical. The euthyroid form is characterized by elevated thyroid autoantibodies (TPO-Ab and Tg-Ab) with thyroid hormone levels remaining within the reference range, whereas the subclinical form is characterized by elevated TSH levels with normal T3 and T4 concentrations. The clinical form is characterized by a further increase in TSH accompanied by a decline in thyroid hormone levels, resulting in more pronounced symptoms and requiring thyroid hormone replacement therapy [1].

The pathophysiology of HT is primarily characterized by a chronic autoimmune response accompanied by low-grade systemic inflammation, which may be present across different stages of the disease. This process may contribute to a broad spectrum of systemic symptoms, including fatigue, reduced energy levels, sleep disturbances, changes in body mass, dry skin, hair loss, edema, constipation, bradycardia, muscle cramps, joint pain, cognitive impairment, and depressive symptoms [1]. The presence and combination of these symptoms can substantially impair patients' quality of life [10, 11].

Individuals with HT frequently exhibit alterations in lipid profile, including elevated triglyceride, total cholesterol, and low-density lipoprotein (LDL) cholesterol levels, together with reduced high-density lipoprotein (HDL) cholesterol levels [12, 13]. Furthermore, the autoimmune process has been associated with endothelial dysfunction, which may further increase the risk of atherosclerosis and cardiovascular complications [14].

Reduced thyroid function has significant consequences for both the muscular and cardiovascular systems. Thyroid hormones play an important role in regulating skeletal and cardiac muscle contractility; therefore, thyroid hormone deficiency may lead to reduced muscle strength, stroke volume, and cardiac output, accompanied by increased peripheral vascular resistance and reduced cardiac and pulmonary reserve [15]. Consequently, cardiorespiratory fitness may decline, as reflected by reduced maximal oxygen uptake (VO_2max) and exercise tolerance, particularly during higher-intensity exercise [16, 17].

In addition to hormonal disturbances, the autoimmune process itself may contribute to reduced functional capacity and increased fatigue, even in euthyroid patients. Jordan et al. (2021) demonstrated that euthyroid patients with HT experienced greater physical fatigue, perceived exertion, and muscle pain during the six-minute walk test compared with healthy controls, despite normal neurological and electrophysiological findings [18].

3. The Importance of Physical Activity in Hashimoto's Thyroiditis

Physical activity is increasingly recognized as an important non-pharmacological strategy in patients with HT. Recent studies indicate that exercise may exert beneficial effects on thyroid function, including reductions in TSH levels and increases in free thyroxine (fT4) concentrations [5, 19, 20]. These effects may be partially explained by stimulation of the hypothalamic–pituitary–thyroid axis [21], as well as by increased peripheral deiodinase activity, which may facilitate the conversion of T4 into the more biologically active T3 [22]. Furthermore, the increased metabolic demands associated with physical activity may stimulate greater utilization and turnover of thyroid hormones, thereby indirectly influencing TSH regulation [23].

In addition to its hormonal effects, physical activity plays an important role in regulating body composition, which is particularly relevant in individuals with HT. Reductions in total and visceral adipose tissue, which is metabolically active and contributes to a pro-inflammatory state, may help attenuate the systemic inflammation associated with the disease [24]. Given that chronic low-grade inflammation represents an important pathophysiological mechanism in HT, this effect of exercise may constitute a relevant pathway through which clinical outcomes can be improved. Studies have also demonstrated reductions in inflammatory markers, such as C-reactive protein (CRP), as well as improvements in endothelial function following long-term exercise programs [14, 25].

At the cardiovascular and muscular levels, physical activity contributes to improved cardiac and skeletal muscle contractility, increased stroke volume and cardiac output, and more efficient peripheral oxygen delivery. These adaptations are accompanied by improvements in VO_2max and overall cardiorespiratory fitness [26, 27]. The mechanisms underlying these changes include improved tissue oxygenation, increased capillary density, and the potential modulation of thyroid hormone receptor expression and local deiodinase activity in skeletal muscle [22]. Importantly, improvements in functional capacity have been observed even in the absence of significant changes in body mass [14, 25], suggesting that exercise exerts beneficial effects on the cardiovascular system independently of weight loss.

Physical activity also has important effects on the psychological aspects of the disease and on quality of life. Regular exercise may contribute to reductions in symp-

toms of depression, anxiety, and stress, as well as to improvements in sleep quality [28]. These effects may be partly explained by exercise-induced changes in neurotransmitters and hormones involved in mood regulation, including serotonin, dopamine, and endorphins [29]. Studies have demonstrated significant improvements in physical and mental health, vitality, and social functioning among individuals participating in structured exercise programs [5, 10]. Given that symptoms such as fatigue, reduced energy levels, and cognitive difficulties frequently persist even in euthyroid patients, these effects are of particular clinical relevance.

4. Barriers to Physical Activity in Hashimoto's Thyroiditis

Although current scientific evidence supports the use of physical activity in individuals with HT, it remains insufficiently recognized and integrated into the management of these patients. Based on a review of the available scientific literature and clinical experience with this population, the barriers to physical activity can be classified into several categories: physical barriers related to disease symptoms, psychological barriers, barriers associated with inadequately adjusted pharmacological treatment, barriers related to modern lifestyle and poor time management, and barriers arising from limitations in professional guidance and the implementation of exercise program.

4.1. Physical Barriers Related to Symptoms

In individuals with HT and hypothyroidism, even when receiving adequate thyroid hormone replacement therapy, a combination of objectively reduced exercise tolerance and a subjective feeling of persistent low energy is frequently present, substantially hindering the initiation and maintenance of regular physical activity [1]. Nevertheless, findings from intervention studies indicate that appropriately prescribed and structured aerobic or combined exercise programs can improve functional capacity, mood, and quality of life [9].

Fatigue, lack of energy, and subjective weakness are among the most commonly reported symptoms that reduce motivation and willingness to participate in structured exercise programs, particularly among untreated or suboptimally treated patients [30]. These complaints are not exclusively subjective but are often accompanied by measurable reductions in physical performance. For example, euthyroid patients with HT have been shown to exhibit a progressive decline in performance during the six-minute walk test (negative linear trend), accompanied by greater perceived fatigue and muscle pain compared with healthy controls [18].

Furthermore, individuals with subclinical hypothyroidism have been reported to exhibit reduced maximal exercise capacity and VO_2max, accompanied by more

rapid lactate accumulation, a greater increase in pyruvate levels, and greater reliance on anaerobic metabolism as exercise intensity increases. In practical terms, this metabolic profile manifests as reduced tolerance to higher-intensity physical activity, particularly at and above the anaerobic threshold [17, 31].

From a subjective perspective, survey-based studies indicate that approximately two-thirds of women with hypothyroidism receiving thyroid hormone replacement therapy perceive their condition as limiting their ability to engage in physical activity, with these limitations being more pronounced in those with autoimmune HT. The most commonly reported complaints include muscle pain, pronounced post-exercise fatigue, prolonged recovery, and a lack of confidence in one's own physical capabilities [30, 32].

4.2. **Psychological Barriers**

Individuals with HT frequently experience psychological disturbances, including depressive mood, anxiety, cognitive difficulties, and persistent fatigue, which may substantially reduce motivation and willingness to engage in regular physical activity [33]. Importantly, these disturbances are not necessarily attributable solely to hormonal imbalance but may also be present in euthyroid patients. Indeed, individuals with HT have been shown to exhibit higher depression and anxiety scores and poorer mental health-related quality of life compared with healthy controls, despite thyroid hormone levels within the reference range. These findings suggest that autoimmunity itself may contribute to psychological well-being and the subjective perception of health [34].

These findings are further supported by meta-analyses indicating that autoimmune thyroiditis is associated with an approximately two- to threefold higher risk of depressive and anxiety disorders [35]. This may consequently lead to reduced initiative, lower energy levels, and avoidance of physical exertion. Together with cognitive difficulties, these disturbances may impair daily functioning and quality of life [36], thereby indirectly hindering the adoption and maintenance of physical activity as part of the daily routine.

Furthermore, women with HT have been reported to exhibit higher levels of psychological distress and somatization, while certain affective temperaments, such as depressive and cyclothymic temperaments, have been associated with greater severity of psychosomatic symptoms [37]. Such patterns may amplify the subjective perception of fatigue, pain, and physical burden, causing even moderate physical exertion to be perceived as excessive or potentially threatening.

Nevertheless, these barriers are not immutable. Research indicates that psychotherapeutic approaches, particularly cognitive behavioral therapy, may reduce stress and depressive symptoms and improve quality of life in these patients [38], potentially reducing psychological resistance to physical activity. In this context, combining psy-

chological support with the gradual and individually tailored introduction of physical activity may produce synergistic benefits.

From a practical perspective, psychological barriers in individuals with HT are therefore clinically relevant but not insurmountable. With appropriate support and carefully prescribed, gradual engagement in physical activity, many patients may enter a positive cycle characterized by increased physical activity levels, improved mood, greater energy, and enhanced overall functional capacity [8, 38].

4.3. Barriers Related to Inadequately Adjusted Pharmacological Treatment

Based on findings from several studies conducted in primary care settings and outpatient populations, approximately 30–50% of treated patients with hypothyroidism have TSH levels outside the target range, indicating suboptimal adjustment of thyroid hormone replacement therapy [39, 40].

Inadequately treated hypothyroidism is associated with reduced cardiac output, muscle weakness, and impaired pulmonary function, which collectively contribute to reduced functional capacity and exercise tolerance. These alterations may further contribute to fatigue, impaired physical functioning, and an overall decline in quality of life [41].

Conversely, excessive thyroid hormone replacement may lead to muscle dysfunction, increased metabolic stress, and cardiovascular instability, including cardiac arrhythmias, which may adversely affect exercise performance and recovery. Excessive replacement therapy has also been associated with impaired physical functioning and an overall reduction in the capacity to engage in physical activity, despite increased metabolic activity [41].

4.4. Barriers Related to Modern Lifestyle and Poor Time Management

Barriers related to modern lifestyle and poor time management represent important factors that may hinder engagement in physical activity. In this context, available data indicate that physical activity levels remain low even among individuals with treated hypothyroidism. In a large study involving 1,724 women, only 16.1% of participants met the recommended levels of physical activity [32]. Studies conducted in the general population and among individuals with chronic diseases have identified lack of time, work-related commitments, caregiving responsibilities, fatigue, and stress as some of the most commonly reported barriers to regular exercise [42, 43]. These factors are often associated with contemporary lifestyle patterns characterized by sedentary behavior, high levels of psychological stress, and difficulties integrating physical activity into daily routines [43].

Although studies specifically examining these organizational barriers in individuals with HT are lacking, it is reasonable to assume that similar patterns may

also be present in this population, an assumption that is further supported by clinical experience with these patients. Moreover, persistent fatigue and reduced energy levels may further complicate the organization of daily activities and make it more difficult to incorporate physical activity into everyday life.

4.5. Barriers Related to Professional Guidance and Exercise Implementation

System-level barriers also represent a significant obstacle to the implementation of physical activity in individuals with HT and have been well documented in the broader context of chronic non-communicable diseases. In particular, insufficient collaboration between healthcare professionals and exercise professionals involved in health-oriented exercise programs, including coaches and physical education professionals, may result in a fragmented approach and a lack of individualized recommendations for patients [44, 45]. In addition, there is a shortage of adequately trained professionals qualified to work with this population, as well as limited availability of educational programs specifically focused on integrating medical and exercise-related principles in the management of individuals with chronic non-communicable diseases [44, 45].

Another important limitation is the absence of official guidelines clearly defining the appropriate type, intensity, and volume of physical activity [46, 47]. Although current scientific evidence increasingly indicates the potential benefits of physical activity in this population, the lack of standardized recommendations limits its practical implementation and may contribute to uncertainty among both healthcare and exercise professionals, as well as among patients themselves [47].

5. Recommendations for Physical Activity in Patients with Hashimoto's Thyroiditis

5.1. Assessment of the Current Clinical Status of Patients with HT Before Initiating a Specific Exercise Program

Before enrolling an individual with HT in an exercise program, an initial assessment of their health status and functional capacity should be performed. This assessment provides the foundation for planning an individualized exercise program and selecting the appropriate type, intensity, and volume of physical activity [48].

However, in individuals with HT, it is important to recognize that symptoms and the subjective perception of exercise readiness may vary considerably from day to day and even throughout the same day. Fluctuations in energy levels, fatigue, mood, and overall physical readiness may result from hormonal variations, psyc-

hological stress, sleep quality, or inadequately adjusted pharmacological treatment [1]. Therefore, before each exercise session, a brief assessment of the patient's current condition is recommended. This may include discussing the presence of symptoms, evaluating the subjective perception of exertion and readiness to exercise, and, when appropriate, assessing simple objective indicators such as heart rate or blood pressure [49].

In this context, exercise programs should not be implemented rigidly but should instead be adjusted according to the patient's current subjective and objective condition. Individualization and flexible modification of exercise load in response to daily variations represent one of the fundamental principles of the safe and effective implementation of physical activity in individuals with HT [50].

5.2. Exercise Program Planning and Periodization

The initial information obtained by the coach or exercise professional from the patient should serve as the basis for precise planning and periodization of the exercise load. Key aspects that should be evaluated include the patient's current subjective and objective condition, recent laboratory findings, particularly TSH levels, previous training experience, and current level of physical fitness. Physical fitness can be assessed using simple and practically applicable tests, such as cardiorespiratory fitness tests (e.g., a step test or a cycle ergometer test with controlled workload), as well as indirect assessments of muscular strength and endurance (e.g., the number of squat or push-up repetitions or the duration of a plank hold) [51, 52].

Maximum heart rate (HRmax) is another important variable that can be used to define exercise intensity zones. In general, exercise intensities below approximately 80% of HRmax predominantly involve aerobic metabolism, whereas higher intensities are associated with a greater anaerobic contribution, although several distinct exercise intensity zones can be differentiated in practice [53]. Based on these parameters, exercise should be planned according to the principles of systematic and gradual progression, with a progressive increase in exercise load, progression from simpler to more complex exercises, and adequate time allocated for recovery.

The periodization of the exercise program should also account for daily and weekly fluctuations in the patient's condition. More demanding training microcycles may be planned during periods when the patient feels well rested, has higher energy levels, and reports a better mood, whereas reduced-load or recovery microcycles are recommended during periods of more pronounced fatigue. Such a flexible and individualized approach allows for a gradual progression through the exercise program, reduces the risk of excessive overload and adverse effects, and increases the likelihood of long-term adherence to the exercise program and the achievement of beneficial health outcomes [50, 54].

5.3. Monitoring Exercise Load and Response to Training

During exercise sessions, continuous monitoring of both subjective and objective indicators of exercise intensity and load is recommended. Heart rate represents one of the primary objective indicators and can be used to estimate the intensity zone in which the patient is exercising, as well as their ability to recover after exercise, since the rate of heart rate decline following exertion is an important indicator of physical fitness and exercise tolerance [55].

Particular attention should be paid to patients with inadequately controlled hypothyroidism and elevated TSH levels, in whom bradycardia may be present, making it difficult to reach higher heart rate values despite a subjectively high level of exertion [41]. In such situations, excessive exertion should be avoided, and exercise intensity should also be guided by other indicators. Conversely, in patients receiving excessive thyroid hormone replacement, a disproportionately high heart rate response may occur even at relatively low exercise loads, requiring additional caution and appropriate limitation of exercise intensity [41].

Given these specific considerations, monitoring the subjective perception of exertion is particularly important. Standardized rating scales, such as the Borg Rating of Perceived Exertion (RPE) scale [56], may be used for this purpose, together with direct communication with the patient through simple questions regarding fatigue, breathing, and overall perceived exertion. In addition, the patient's response during the post-exercise recovery period should be monitored, including their subjective condition on the following day. Another useful strategy is to encourage patients to report their physical and subjective condition after exercise sessions, thereby providing a better understanding of their individual response to exercise load and allowing further optimization of the exercise program [57].

5.4. Coordination of Exercise Training with Pharmacological Treatment and Interdisciplinary Collaboration

Coordinating the exercise program with pharmacological treatment represents one of the key aspects of the safe and effective implementation of physical activity in individuals with HT. A particular challenge is posed by patients in whom a stable thyroid hormone replacement regimen has not yet been established, which is most commonly encountered during the initial stages of treatment, when the body is still adapting to therapy [17]. Additional caution is required when pharmacological treatment and an exercise program are initiated simultaneously. In such cases, based on clinical experience, a gradual and conservative approach is recommended, with substantial increases in exercise intensity postponed until relative stabilization of thyroid hormone status has been achieved [17].

In this context, interdisciplinary collaboration between exercise professionals and endocrinologists is particularly important. Two-way communication enables

better coordination between pharmacological treatment and exercise load, thereby reducing the risk of adverse effects and potentially improving the effectiveness of the intervention [32]. Feedback from exercise professionals regarding symptoms, energy levels, and exercise tolerance may provide valuable information to the endocrinologist when assessing the adequacy of thyroid hormone replacement therapy. Such collaboration should be continuous, given that significant changes in body composition, metabolism, and functional capacity may occur throughout the exercise program [9].

Conversely, inadequately prescribed exercise loads may result in adverse effects, including increased fatigue and symptoms of excessive training stress [58], further emphasizing the need for careful monitoring and timely communication with the treating physician. Importantly, HT itself does not constitute a contraindication to physical activity, and most patients can exercise safely when following an appropriately prescribed and supervised program [9]. Nevertheless, given the systemic nature of the disease, some patients may present with additional health conditions, including cardiovascular disorders [59]. In such cases, further evaluation by a cardiologist or sports medicine specialist may be recommended before initiating an exercise program.

5.5. Recommended Exercise Modalities and Types of Physical Activity

As previously emphasized, physical activity should be introduced gradually, progressing from less demanding to more challenging forms of exercise, with a progressive increase in exercise volume and intensity. During the initial stages, priority should be given to aerobic activities such as walking, swimming, hiking, cycling, rollerblading, or dancing. Given the frequently elevated levels of stress among individuals with HT, an important component of the exercise program should also include relaxation-oriented activities, such as breathing exercises, stretching, yoga, tai chi, and similar forms of exercise [60].

The weekly volume of physical activity should be aligned with general recommendations while also taking into account the individual capabilities of each patient. Accordingly, a total of 150–300 minutes of moderate-intensity physical activity per week is recommended. In practice, this can be achieved in different ways, for example through three exercise sessions per week lasting 45–60 minutes or through more frequent, shorter bouts of daily activity [61]. In terms of walking, this may correspond approximately to 7,000–10,000 steps per day or approximately 5–7 km of walking, distributed throughout the week [62].

In addition to moderate-intensity activity, smaller amounts of higher-intensity exercise may also be introduced, for example two to three times per week, depending on the patient's current condition and exercise tolerance [61]. This is particularly relevant given that individuals with HT may exhibit reduced cardiorespiratory fitness and lower levels of muscular strength [48, 61].

Accordingly, resistance training should also represent an important component of the exercise program and may be performed two to three times per week [63]. During the initial stages, bodyweight exercises may be used, followed by the gradual introduction of external resistance, such as dumbbells, kettlebells, resistance bands, or barbells [27]. Exercise load may be prescribed according to the number of repetitions, with 15–20 repetitions per set recommended for lighter loads and 8–12 repetitions per set for higher loads [27].

To improve cardiorespiratory fitness, higher-intensity exercise modalities may also be incorporated, including combined exercise programs consisting of aerobic exercise using ergometers or other exercise equipment together with resistance exercises [5], as well as high-intensity interval training (HIIT) [64]. However, HIIT may be demanding for some patients because of the rapid transitions from recovery to very high-intensity effort and the relatively short recovery periods between intervals [64].

Therefore, as a potentially more practical and tolerable alternative, we propose variable-intensity interval training (VIIT), which involves alternating exercises of different intensities separated by recovery periods. More specifically, a higher-intensity exercise is followed by a recovery period, then by a lower-intensity exercise and another recovery period (e.g., high-knee running followed by recovery, then a slow, controlled squat followed by recovery). This approach allows patients to exercise at higher intensities while providing sufficient recovery time and may also enable a greater overall exercise volume because the session can be sustained for a longer duration. In addition, dynamic variation in exercise intensity and exercise type may make the training session more engaging and subjectively less strenuous [65]. Similar exercise protocols have demonstrated beneficial outcomes in other populations [65]. More importantly, our recent study specifically examining VIIT in women with HT demonstrated improvements in cardiorespiratory fitness, body composition, and several domains of quality of life, together with a significant reduction in TSH levels in women with subclinical HT [66].

Regardless of the exercise modality, each session should conclude with stretching and relaxation exercises [60]. Finally, it is important to reiterate that physical activity should always be individually tailored to the patient's current condition, capabilities, and preferences, as this represents a key prerequisite for long-term adherence to the exercise program and the achievement of the desired health benefits [48].

6. Conclusion

Hashimoto's thyroiditis is a complex condition that, in addition to hormonal disturbances, involves a range of functional and psychological alterations that may hinder engagement in physical activity. Despite the presence of numerous barriers, available evidence and clinical experience indicate that appropriately prescribed and

individually tailored physical activity can substantially improve functional capacity, quality of life, and overall health status in these patients.

The key to successful implementation lies in the gradual introduction of physical activity, individualization of the exercise program, careful monitoring of responses to exercise load, and appropriate coordination of exercise training with pharmacological treatment. Combined exercise modalities incorporating aerobic exercise, resistance training, and controlled interval-based methods may be particularly valuable.

Despite the growing body of evidence, physical activity remains insufficiently integrated into the standard management of patients with HT, while the lack of clear guidelines continues to limit its practical implementation. Therefore, further efforts are needed to bridge the gap between scientific evidence and clinical practice, with the aim of establishing physical activity as an integral component of the therapeutic approach for individuals with Hashimoto's thyroiditis.

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