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Socijalna izolacija i blagostanje u starosti

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SAŽETAK

Strukturalni aspekti socijalne mreže predstavljaju kanale koji služe kao facilitatori socijalnog angažovanja i omogućavaju pristup razmeni različitih vrsta psihološke podrške i instrumentalne pomoći. S obzirom na to da se socijalna mreža u starosti sužava i socijalna podrška se smanjuje, stare osobe imaju poseban rizik od socijalne izolacije. Imajući u vidu potencijalno štetne efekte socijalne izolacije po sveukupno blagostanje starih, cilj ovog istraživanja je da ispita strukture razlika u blagostanju starih osoba koje su dobro integrisane u socijalnu mrežu i onih koji su pod rizikom od socijalne izolacije. Blagostanje starih je određeno preko zadovoljstva životom (kognitivna komponenta subjektivnog blagostanja), odsustva depresivnih simptoma i osećanja usamljenosti (kao afektivnih komponenata subjektivnog blagostanja), smisla života kao indikatora psihološkog blagostanja, te stepena rezilijentnosti. U istraživanju je učestvovalo 294 ispitanika, prosečne starosti 75 godina (66% ženskog pola), koji su popunili Lubbenovu skalu socijalne mreže (LSNSS), Skalu zadovoljstva životom (SWLS– 3), Skalu smisla života (MLQ). Subskalu Depresivnosti iz Skale DASS-21; De Jong Gierveld skalu usamljenosti (DJGLS) i Kratku skalu rezilijentnosti (BRS). Da bi se odgovorilo na postavljeni istraživački cilj sprovedena je diskriminativna analiza. U ispitanom uzorku detektovano je 28.1% starih osoba pod rizikom od socijalne izolacije. Izdvojena je jedna značajna diskriminativna funkcija koju definiše visoko zadovoljstvo životom, visoka rezilijentnost i smisao života, te niska depresivnost i usamljenost. Rezultati pokazuju da grupa socijalno izolovanih starih ima statistički značajno niži nivo blagostanja u odnosu na grupu starih koji su dobro integrisani u socijalnu mrežu, te potvrđuju da su socijalni odnosi važna determinanta blagostanja u starosti.

Ključne reči: socijalna mreža, blagostanje, socijalna izolacija, stari

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Uvod

Zadovoljavanje potrebe za povezanošću, kao jedne od bazičnih psiholoških potreba, smatra se fundamentalnim za ostvarenje blagostanja (Diener & Seligman, 2002) tokom čitavog životnog veka (Antonucci, 2001). Rezultati istraživanja nedvosmisleno potvrđuju da osobe koje su bolje integrisane u socijalnu mrežu i koje imaju zadovoljavajuće odnose sa drugima imaju tendenciju da duže žive, te imaju bolje mentalno i fizičko zdravlje (Reis et al., 2000; Umberson et al., 2010; Vozikaki et al., 2017). Povezanost sa drugima postaje posebno značajna u starom dobu, jer se socijalna mreža prirodno sužava (Cukrowicz et al., 2008; Portero & Oliva, 2007), a ona ima vitalnu ulogu u procesu uspešnog starenja, s obzirom na to da ublažava nepovoljne efekte očekivanih, razvojnih stresora u starosti (Vonneilich et al., 2012). Kako u starosti opada i stepen autonomije, stare osobe pokazuju veću zavisnost od svojih socijalnih mreža kako bi im pružile željene resurse i podršku u zadovoljavanju različitih potreba (Ye & Zhang, 2019). Povezanost sa drugim ljudima stari vide kao centralnu odrednicu kvalitetnog života u starosti (Hemingway & Jack, 2013), a upravo je ova potreba u starosti najugroženija (Petrović i Jović, 2018). Meta-analitičke studije govore u prilog tome da je zadovoljavanje bazičnih psiholoških potreba kod starih povezano sa pozitivnim indikatorima blagostanja (smisao života, zadovoljstvo životom, pozitivni afekat i sl.), dok je u negativnoj relaciji sa indikatorima poput depresivnog afekta (Tang et al., 2020).

Socijalna mreža uključuje skup ljudi iz nečijeg socijalnog sveta, i može biti izučavana na različite načine. Naime, strukturalni pristup izučavanju socijalne mreže podrazumeva širinu socijalne mreže, vrstu odnosa i učestalost interakcija između pojedinaca, socijalnu participaciju, te životne aranžmane poput samačkog života (Berkman et al., 2000; Smith & Christakis, 2008). Istraživačka paradigma koja razmatra funkcionalne aspekte socijalne mreže, poput percepcije socijalne podrške i osećanja usamljenosti dopunjava se i pristupom koji insistira na kvalitetu odnosa između članova unutar socijalne mreže (Holt-Lunstad et al., 2015). Dakle, socijalne mreže pojedinaca se razlikuju po svojoj strukturi, funkciji i kvalitetu odnosa sa drugim članovima mreže, i svi ovi aspekti su snažno isprepleteni. Naime, strukturalni aspekti socijalne mreže predstavljaju kanale koji omogućavaju uključivanje u socijalne aktivnosti (socijalnu participaciju) i pristup razmeni

različitih vrsta socijalne, emocionalne i psihološke podrške, te instrumentalne pomoći (Moren-Cross & Lin, 2006). Širina socijalne mreže predviđa dostupnost socijalne podrške (Litwin & Landau, 2000; Santini et al, 2015), tačnije - što je uža socijalna mreža to je i socijalna podrška manja (Guadalupe & Vicente, 2021; Harasemiw et al., 2018). Uopšteno govoreći, istraživanja pokazuju da održavanje stabilnog broja bliskih socijalnih relacija ima povoljan uticaj na subjektivno blagostanje starih odraslih (Charles & Carstensen, 2010). Rezultati meta-analitičkih studija na starima upozoravaju na to da je uticaj nedovoljne integrisanosti u socijalnu mrežu na rizik od mortaliteta potencijalno štetniji od poznatih faktora rizika poput prekomernog konzumiranja alkohola i cigareta, gojaznosti i nedostatka vežbanja (Holt-Lundstad et al., 2010). Novija istraživanja jasno usmeravaju na zaključak da i kvantitet i kvalitet socijalnih relacija predstavljaju značajne prediktore blagostanja i zdravlja kod starih (Guadalupe & Vicente, 2021; Santini et al., 2015; Schutter et al., 2022; Sun et al., 2020; Xing et al., 2017). Svakako da gubici u sferi međuljudskih odnosa koji su češći u starosti, a zatim gubici vezani za zdravlje i društvene uloge doprinose suženju socijalne mreže i nižoj učestalosti socijalnih interakcija, te pojačavaju zdravstvene i psihosocijalne rizike. S druge strane, teorija socioemocionalne selektivnosti sugeriše da sa starenjem, odnosno percepcijom vremena kao ograničenog, socijalna mreža postaje sve selektivnija, te se voljno sužava u korist manjeg broja visokokvalitetnih bliskih odnosa (Carstensen et al., 1999; Fung et al.; 2001; Lang & Carstensen, 1994). Evidentne promene u veličini socijalne mreže i učestalosti kontaktiranja, te nižoj participaciji a time i socijalnoj podršci u starosti su obuhvaćene terminom socijalna izolacija.

Socijalna izolacija je višedimenzionalni konstrukt koji se može definisati kao neadekvatan kvantitet i/ili kvalitet interakcija sa drugim ljudima (Smith & Lim, 2020; Zavaleta et al., 2017). Objektivne mere socijalne izolacije odnose se na objektivno nisku učestalost socijalnih interakcija, te nedostatak društvenih kontakata sa članovima porodice, prijateljima ili širom zajednicom (Beller & Wagner, 2018; Valtorta & Hanratty, 2012), dok se subjektivnim merama smatraju stepen zadovoljstva postojećim socijalnim interakcijama i osećaj usamljenosti. Socijalna izolacija i usamljenost, iako često korišćeni kao sinonimi zbog svoje konceptualne povezanosti (Dickens et al., 2011), zapravo se razlikuju: dok je izolacija povezana sa nedostatkom strukturalne i funkcionalne podrške (Wenger & Burholt, 2004), usamljenost je subjektivno

neprijatno osećanje povezano sa uočenim nedostatkom šire društvene mreže (socijalna usamljenost) ili odsustvom specifičnog emocionalnog odnosa (emocionalna usamljenost) (de Jong Gierveld et al., 2006; Valtorta & Hanratty, 2012). Drugim rečima, usamljenost se smatra percipiranom socijalnom izolacijom (Cacioppo & Cacioppo, 2014). Iako se usamljenost smatra gotovo univerzalnim fenomenom u starosti, odnosno neizbežnim rezultatom starenja (Wood, 2013), ona zapravo nastaje kao posledica percepcije nesklada između željenog i ostvarenog broja socijalnih kontakata i/ili stepena bliskosti (kvaliteta) u socijalnim odnosima (De Jong Gierveld & Havens, 2004). Kao što je pomenuto, često se u istraživanjima ne razdvajaju usamljenost i društvena izolacija, što može biti prepreka u intervencijama podrške starijim osobama (Beller & Wagner, 2018), jer osoba može imati osećaj usamljenosti i pored učestalih kontakata sa drugima, i obrnuto, ne mora se osećati usamljeno u situacijama kada je kontakt sa drugima ograničen (Hughes et al., 2004). Ovo potvrđuju i istraživanja koja registruju nisku do srednju povezanost između ova dva fenomena (Cornwell & Waite, 2009), te ona koja pokazuju da je objektivna socijalna izolacija preduslov usamljenosti (Santini et al., 2015), kao i to da je usamljenost jače povezana sa kvalitetom a ne sa kvantitetom socijalnih interakcija (Hawkley et al., 2008). Nedostatak socijalnih kontakata, strukturalne i funkcionalne podrške se tako smatraju izvorom i generatorom negativne spirale koja dalje može da vodi do percipirane socijalne izolacije i afektivnih poremećaja u starom dobu (Santini et al., 2015), te se stoga insistira da prioritet treba dati strateškim intervencijama usmerenim na promociju i unapređenje (povećanje) socijalnih kontakata među starima (Chen & Schulz, 2016; Holt-Lunstad et al., 2010).

Većina postojećih istraživanja efekata socijalne izolacije, mahom se i odnose na stariju populaciju (Nyqvist et al.,2016), pretpostavljajući da okolnosti poput smrti supružnika, prijatelja i siblinga, bolesti, ograničene fizičke pokretljivosti, penzionisanja, smanjenja prihoda, snižene autonomije, te samačkog života čine socijalnu izolaciju izvesnijom (Cornwell & Waite, 2009; Kemperman et al., 2019; Umberson, & Montez, 2010). Sužene socijalne mreže, te niska učestalost socijalnih interakcija, najpre sa članovima porodice i prijateljima, a onda i sa širom društvenom okolinom za stariju populaciju znači nedostatak resursa i različitih izvora podrške. Premda su istraživanja koja u fokusu imaju socijalnu izolaciju starih ređa u odnosu na ona koja ispituju usamljenost, kao i ona koja odvajaju efekte socijalne

izolacije od efekata usamljenosti, ima onih koja jasno upućuju na to da socijalna izolacija korelira sa nižim nivoima subjektivnog blagostanja (Chappell & Badger, 1989), uključujući nizak nivo zadovoljstva životom i viši nivo depresivnih simptoma (Nakagomi et al., 2023; Usher et al., 2020). Takođe, socijalna izolacija je povezana sa nedostatkom smisla života (AshaRani et al., 2022., Pinquart, 2002; Steptoe & Fancourt, 2019) i usamljenošću kod starih (Chan et al., 2023; Kemperman et al., 2019; Kuru Alici & Kalanlar, 2021). Istraživanja pokazuju jak uticaj socijalne izolacije ne samo na blagostanje starih, već i na fizičko zdravlje (Nakagomi et al., 2023). Meta-analitičke studije sugerišu da socijalna izolacija povećava verovatnoću prerane smrtnosti za 50% (Holt-Lunstad et al., 2010; Steptoe et al., 2013), te rizik od demencije (Fratiglioni et al., 2000; Kuiper et al., 2016; Shen et al., 2022).

Pandemija COVID-19 je posebno istakla negativne efekte socijalne izolacije i usamljenostipo zdravlje i psihološko blagostanje kod starih i ubrzala napore ka ranoj detekciji i kreiranju intervencija (Horgan et al., 2024). Danas je jasno da su ovi fenomeni od prioritetnog značaja za javno zdravlje na globalnom nivou (WHO, 2021) jer se prevalenca socijalne izolacije starih kreće u opsegu 7-24% (Newall, & Menec, 2019; WHO, 2021). Mnoga istraživanja pokazuju da iskustva socijalne izolacije i usamljenosti kod starih prođu neopaženo i ne detektuju se na vreme (Morlett Paredes et al., 2021). Uvremenjena identifikacija starih pod rizikom i rana intervencija su se pokazale ključnima za prevenciju štete koju produženo iskustvo socijalne izolacije i usamljenosti ima na sveukupno psihofizičko zdravlje starih (Horgan et al., 2024; Su et al., 2023).

Blagostanje u starosti

U obilju istraživačkih napora da se definiše blagostanje, izdvajaju se dve tradicije. Hedonistički pristup blagostanje definiše kao kognitivnu i afektivnu evaluaciju sopstvenog života (Diener, 2000) i čine ga tri komponente: zadovoljstvo životom (kognitivni aspekt subjektivnog blagostanja, tj. procena osobe o tome kakav je njen život), pozitivni afekat (česta iskustva prijatnih emocija), te nizak nivo negativnog afekta (retko doživljavanje neprijatnih emocionalnih stanja i relativno odsustvo osećanja depresivnosti i anksioznosti; Deci & Ryan, 2008; Lucas, et al., 1996). Druga

istraživačka paradigma, tj. eudajmonistički pristup naglašava samorealizaciju (usklađenost sa sopstvenim selfom) i smisao (Ryan & Deci, 2001; Ryff, 1989; Waterman et al., 2010). Smatrajući da je psihološka dobrobit više od zadovoljstva i osećanja sreće, Rifova (Ryff, 1989) formuliše integrativni model psihološkog blagostanja (prvobitno nazvan modelom uspešnog starenja), a koji je zasnovan na pretpostavci da individue teže punom funkcionisanju i realizaciji sopstvenih jedinstvenih talenata. Dimenzije ovog modela čine: samoprihvatanje (pozitivne evaluacije o sebi), personalni rast (realizacija sopstvenih potencijala), smisao života (verovanje da je nečiji život smislen i svrhovit), pozitivni odnosi sa drugima (visok kvalitet odnosa), ovladavanje okruženjem (kapacitet efektivnog suočavanja sa zahtevima svakodnevice i stresnim okolnostima), kao i autonomno funkcionisanje (Ryff & Singer, 2008). Slično tome, teorija samoodređenja (Ryan & Deci, 2000) je jedna od najvažnijih perspektiva zasnovanih na eudajmonističkom pristupu, i sugeriše da blagostanje čine zadovoljene potrebe za autonomijom, kompetencijom i povezanošću sa drugima. U literaturi se u okviru hedonističkog pristupa govori o subjektivnom blagostanju (Keyes et al., 2002), dok se za eudajmonistički pristup vezuje koncept psihološkog blagostanja (Extremera et al., 2011).

Iako bi bilo opravdano pretpostaviti da različiti gubici vezani za starost mogu uticati na opadanje blagostanja kod starih, istraživanja zapravo pokazuju da blagostanje ostaje stabilno ili čak raste u poznim godinama (Wettstein et al., 2016). Meta-analitičke studije nalaze relacije oblika slova “U” između starosti i blagostanja, pri čemu se najveći pad beleži u srednjim godinama (Blanchflower, 2021). Druga istraživanja pokazuju minimalne varijacije u nivou blagostanja nakon 40 godina života (Diener et al., 1999), dok longitudinalne studije potvrđuju stabilnost ili povećanje blagostanja u starosti (Biermann et al., 2022; Cheng et al. 2017; Jivraj et al., 2014) koje se u literaturi naziva paradoksom blagostanja (Blanchflower & Oswald, 2008). Međutim, neki autori upućuju na to da ovo ne važi za sve indikatore blagostanja (Galambos et al., 2020), te da se rezultati istraživanja koji govore o ovom paradoksu uglavnom odnose na kognitivnu komponentu subjektivnog blagostanja (Blanchflower, 2020), da pozitivan afekat opada sa uzrastom, dok negativni raste u trećem životnom dobu (Pinquart, 2001). Stoga se u novijim istraživanjima insistira da se u indikatore blagostanja kod starih,

pored kognitivne i emocionalne komponente uvrste i indikatori koji govore o psihološkom blagostanju (Hansen & Blekesaune, 2022; Vittersø, 2013). Iako ređa, istraživanja koja uključuju indikatore psihološkog blagostanja pokazuju da neke od komponenata poput osećaja kontrole, personalnog rasta i smisla života opadaju sa uzrastom (Keyes et al., 2002; Mackenzie et al., 2018; Pinquart, 2002; Ryff, 2014; Ryff & Keyes, 1995).

Predmet istraživanja

S obzirom na flagrantni nedostatak istraživanja na uzorcima starih u Srbiji, kao i na teorijske implikacije i značaj socijalne izolacije u trećem dobu, ovo istraživanje je posebno važno. Njegov opšti cilj jeste ispitivanje strukture razlika u blagostanju starih osoba koje su dobro integrisane u socijalnu mrežu i onih koje su pod rizikom od socijalne izolacije.Blagostanje starih će u ovom istraživanju biti određeno preko zadovoljstva životom (kognitivna komponenta subjektivnog blagostanja) i odsustva depresivnih simptoma i osećanja usamljenosti (kao afektivnih komponenata subjektivnog blagostanja). Pored ovih dveju komponenata, uvrstili smo i smisao života kao indikator psihološkog blagostanja. I na kraju, govoriti o blagostanju bez pominjanja rezilijentnosti, naročito kod starih je gotovo nemoguće (Srivastava, 2011). S obzirom na to da su indikatori subjektivnog blagostanja smatrani ranim deskriptorima rezilijentnosti (Wagnild & Young, 1990) i polazeći od definicije rezilijentnosti kao sposobnosti da se održi ili povrati psihološko blagostanje u suočavanju sa izazovima (Ryff et al., 2012), uvrstili smo i rezilijentnost u skup varijabli koje govore o blagostanju starih. Rifova je sugerisala da pomenute dimenzije psihološkog blagostanja služe kao empirijski indikatori kapaciteta osobe da funkcioniše u situacijama životnih izazova, tačnije – da govore o rezilijentnosti (Ryff et al., 2012), što zapravo i potvrđuju neka istraživanja na uzorcima starih (Mohammed et al., 2024; Tomas et al., 2012). Indikatori blagostanja i rezilijentnosti se u literaturi opisuju kao ključni elementi uspešnog starenja (Wagnild, 2003).

Imajući u vidu teorijske koncepcije i empirijska istraživanja o kojima je bilo reči u uvodu, može se očekivati postojanje razlika među starim osobama koje su dobro integrisane u socijalnu mrežu, i starima koji su u riziku od socijalne izolacije, po stepenu rezilijentnosti, doživljaju smisla života i zadovoljstva životom, kao pozitivnim indikatorima blagostanja, te

depresivnosti i osećanju usamljenosti kao negativnim indikatorima. Ovo istraživanje ima za cilj da ispita strukturu razlika između ove dve grupe starih ispitanika.

Metod

Uzorak i procedura

U istraživanju je učestvovalo 238 ispitanika, starosti od 65 do 90 godina (*M* = 75.34, *SD* = 6.54), od kojih 66% žena. Detaljniji opis uzorka prikazan je u Tabeli 1.

Tabela 1

Demografske karakteristike uzorka (N=238)

Varijabla	Kategorije varijable	*N*	%
Pol	Muški	81	34.0
	Ženski	157	66.0
Starost	Mlađi (65-74)	118	49.6
	Stariji (75-90)	120	50.4
Mesto stanovanja	Grad	124	52.3
	Manji grad	64	27.0
	Selo	49	20.7
Stepen obrazovanja	OŠ	62	26.4
	SSS	93	39.6
	VSS/VS	72	30.6
	MAG/DR	8	3.4
Partnerski status	U braku	78	32.9
	Razveden/na	31	13.1
	Neudata/neoženjen	12	5.1
	Udovac/udovica	116	48.9
Domaćinstvo	Sam/a u svom domaćinstvu	41	17.3

Sam/a u domu	91	38.4
Sa supružnikom/com i/ili decom u domaćinstvu	71	29.9
U domu sa cimerom/kom	34	14.3

Proces prikupljanja podataka odvijao se tokom 2023. godine. Istraživanje je sprovedeno na teritoriji Vojvodine, u domovima za starija lica, kao i u privatnim domaćinstvima. Ispitivanje se obavljalo individualno, a kao ispitivači su bili angažovani psiholozi zaposleni u domovima za starija lica i studenti master studija psihologije. Ispitanici i ispitanice su davali pismenu saglasnost za učešće u istraživanju, i anonimnost u celom procesu istraživanja je bila zagarantovana. Uzorak je bio prigodan, a istraživanje je odobreno od strane Etičke komisije Filozofskog fakulteta, Univerziteta u Novom Sadu.

Instrumenti

Najveći broj instrumenata korišćen u ovom istraživanju je skraćen, konstruisan i prilagođen za upotrebu sa starim osobama, a u skladu sa preporukama iz dostupne literature.

Lubbenova skala socijalne mreže (The Lubben Social Network Scale – LSNS; Lubben, 1988; Lubben et al., 2006)

Lubbenova skala socijalne mreže (LSNS) je jedna od najčešće korišćenih skala za detekciju socijalne izolacije kod starijih osoba merenjem percipirane socijalne podrške. U skladu sa istraživačkim nalazima da su članovi porodice i prijatelji osnovne strukturalne dimenzije društvenih odnosa u starijoj populaciji, koje služe i kao izvori podrške i kao facilitatori socijalnog angažovanja (Berkman et al., 2000, Lubben, 1988), LSNS procenjuje prirodu i obim (veličinu, bliskost i učestalost konatakata) rodbinskih i prijateljskih veza. Skala ima dve forme, dužu (12 ajtema) i kraću (6 ajtema). Istraživanja pokazuju da je kraća verzija skale prikladnija za detekciju socijalne izolacije (Lubben et al., 2006). U istraživanju je korišćena kraća verzija skale, čiji sadržaj procenjuje broj članova porodice i prijatelja sa kojima se osoba viđa

ili čuje barem jednom mesečno, može ih pozvati u pomoć ili može razgovarati o privatnim stvarima ("Sa koliko ljudi se: viđate ili čujete barem jednom mesečno/osećate da možete razgovarati o privatnim stvarima/osećate dovoljno bliskima da bite mogli da ih pozovete u pomoć?"). Ajtemi su podeljeni u u dve subskale – tri ajtema se odnose na porodične odnose, a preostala tri na vanporodične, odnosno prijateljske odnose. Format odgovora čini šestostepena Likertova skala koja se kreće od "niko" do "9 i više ljudi". Ukupan skor se kreće u teorijskom rasponu – 0-30 (Lubben et al., 2006). Luben i saradnici (2006) su predložili kat-of skor od 12, gde se skor manji od predloženog smatra rizikom od socijalne izolacije. Kada se skala primenjuje na starim ispitanicima, pokazuje solidna psihometrijska svojstva, kako u originalnom istraživanju (alfa = 0,83; Lubben et al., 2006), tako i u validacionim istraživanjima (Chan et al., 2023; Jang et al., 2022). Kronbahova alfa skale u ovom istraživanju iznosi .88.

Skala zadovoljstva životom – 3 (Satisfaction With Life Scale – 3: SWLS; Kjell & Diener, 2021)

Ova skala je namenjena proceni generalnog zadovoljstva životom putem 3 stavke. Ispitanici odgovor daju u rasponu od 1 (*potpuno netačno*) do 5 (*potpuno tačno*), gde viši skor ukazuje na veći stepen zadovoljstva. Ova skraćena skala, po našim saznanjima, nije validirana na uzorku starih, a pouzdanost skale u ovom istraživanju je dobra i iznosi .83.

Smisao života (The Meaning in Life Questionnaire – MLQ; Steger et al., 2006)

Originalnu verziju upitnika čini 10 stavki, na koje se odgovara putem sedmostepene skale (1 = *potpuno netačno*; 7 = *potpuno tačno*). S obzirom na to da su se jedno-ajtemske mere smisla života pokazale validnim i pouzdanim (Atroszko et al., 2015), u ovom istraživanju je korišćena samo jedna stavka, operacionalizovana kroz tvrdnju „Imam osećaj da moj život ima jasnu svrhu", sa petostepenom Likertovom skalom zbog specifičnosti uzorka (radi što manjeg opterećenja ispitanika), tako da viši skor ukazuje na viši stepen smisla života.

Subskala Depresivnosti iz Skale depresivnosti, anksioznosti i stresa (Depression, Anxiety and Stress Scale – DASS-21; Lovibond & Lovibond, 1995)

Subskala se sastoji od 7 stavki (npr. „Osećao sam da nemam čemu da se nadam.“). Sadržaj stavki odnosi se na procenu osnovnih simptoma depresije: nizak pozitivni afekat, disforičnost, beznadežnost, gubitak interesovanja, inertnost, negativan stav prema sebi i životu generalno. Ispitanici su na skali od 0 (*nimalo*) do 3 (*uglavnom ili skoro uvek*) izražavali koliko su često tokom protekle sedmice doživljavali stanje opisano u svakoj tvrdnji, tako da viši skor ukazuje na viši stepen depresivnosti. Pouzdanost subskale Depresivnosti se u istraživanjima na uzorcima starih pokazala kao dobra (npr. alfa =.86; Picaza Gorrochategi et al., 2020), dok u ovom istraživanju ona iznosi .89.

De Jong Gierveld skala usamljenosti (De Jong Gierveld Loneliness Scale; de Jong Gierveld & Tilburg, 2006)

Originalni instrument sadrži 11 stavki Likertovog tipa kojima se preko trostepene skale odgovora (1 - *da*; 2 - *povremeno*; 3 - *ne*) procenjuje koliko se osoba trenutno oseća usamljeno. Skala za odgovore je rekodirana tako da viši skor ukazuje na veći stepen usamljenosti. Primeri stavki su: „Imam osećaj praznine.” i „Nedostaje mi prisustvo drugih ljudi oko mene.”. U ovom istraživanju je korišćena kratka verzija skale od 6 ajtema koja se pokazala kao odgovarajuća za detekciju usamljenosti kod starih osoba (de Jong Gierveld & Tilburg, 2006). Koeficijent interne konzistencije u ovom istraživanju iznosi .71.

Kratka skala rezilijentnosti (Brief Resilience Scale – BRS; Smith et al., 2008)

Originalna skala sadrži 6 ajtema petostepenog Likertovog tipa (1 = *potpuno netačno*; 5 = *potpuno tačno*). Na osnovu skora se indikuje stepen sposobnosti ispitanika da se stabilizuje nakon nekog stresnog događaja. Tri ajtema su pozitivno formulisana („Nakon teških trenutaka, brzo se trgnem i vratim u normalu”), dok su tri formulisana negativno („Treba mi puno vremena da prebrodim zastoje u životu”). U ovom istraživanju korićena je skraćena verzija skale, koja se sastoji od tri pozitivno formulisane stavke, tako da veći skor ukazuje na viši stepen rezilijentnosti. Pouzdanost ovako

skraćene skale po našem znanju nije ispitivana, a u ovom istraživanju je dobra (alfa = .86).

Postupak analize podataka

Svi prikupljeni podaci su obrađeni u okviru statističkog programskog paketa IBM SPSS Statistics 23.0.0. Da bi se odgovorilo na postavljeni istraživački cilj sprovedena je diskriminativna analiza kako bi se ispitala struktura razlika između grupa. Grupišuća varijabla bila je socijalna izolacija, sa cut off skorom 12. Prvu grupu čine ispitanici koji su pod rizikom za socijalnu izolaciju, koju čini 28.1% (N = 66) uzorka. Nezavisne varijable činile su: usamljenost, depresivnost, rezilijentnost, zadovoljstvo životom i smisao života.

Rezultati

Analiza deskriptivnih pokazatelja i interkorelacije varijabli

U Tabeli 2 su prikazani deskriptivni pokazatelji i interkorelacije varijabli korišćenih u istraživanju. Gotovo između svih varijabli su dobijene statistički značajne niske do umereno visoke korelacije. Socijalna mreža ostvaruje statistički značajnu negativnu povezanost sa usamljenošću i depresivnošću, a statistički značajnu pozitivnu povezanost sa rezilijentnošću, zadovoljstvom životom i smislom života.

Ispitanici ostvaruju prosečan skor na varijabli socijalne mreže i usamljenost. U odnosu na teorijski prosek, ispitanici ostvaruju niži skor na depresivnosti, a nešto više skorove na rezilijentnosti, zadovoljstvu životom u celini, kao i na varijabli smisao života. Prema vrednostima koeficijenata zakošenosti i spljoštenosti distribucije (skjunis i kurtozis), varijable korišćene u istraživanju imaju normalnu raspodelu skorova.

Tabela 2

Deskriptivni pokazatelji i interkorelacije između ispitivanih varijabli

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Socijalna mreža	1	-.47**	-.33**	.32**	.44**	.29**
(2) Usamljenost		1	.44**	-.29**	-.45**	-.23**
(3) Depresivnost			1	-.45**	-.45**	-.29**
(4) Rezilijentnost				1	.38**	.18**
(5) Zadovoljstvo životom					1	.27**
(6) Smisao života						1
M (SD)	16.39 (6.77)	13.24 (1.65)	4.77 (4.89)	10.44 (3.28)	10.50 (3.11)	5.75 (2.04)
Teorijska M	15	12	10.5	9	9	6
Skjunis	-.17	.43	1.32	-.39	-.35	-.03
Kurtozis	-.52	-.56	1.47	-.68	-.74	-.207

** $p < .01$.

Diskriminativna analiza

Pre izvođenja diskriminativne analize sprovedeno je poređenje grupa ispitanika različitog pola i starosti (mlađi i stariji stari) na ispitivanim varijablama. Nije bilo statistički značajih razlika u varijansi ispitivanih varijabli u ovim grupama (Leveneov F test), niti u vrednostima aritmetičkih sredina (t-test za nezavisne uzorke), osim u dva slučaja: Leveneov F test je značajan za varijablu smisao života, za varijanse grupe mlađih odnosno starijih ispitanika ($F(236) = 6.61$, $p = .01$) i t-test je značajan za varijablu rezilijentnost za grupe muških i ženskih ispitanika ($t(236) = 3.015$, $p = .003$). Ipak, zaključeno je da se ne radi o velikim razlikama među (pod)grupama ispitanika i pristupljeno je daljim analizama pod pretpostavkom da je ispunjen uslov homogenosti (varijanse).

Na osnovu predloženog kat-of skora na varijabli socijalna mreža (Lubben et al., 2006), formirane su dve grupe ispitanika – grupa pod rizikom od socijalne izolacije i grupa bez rizika. Na ovaj način detektovano je 28.1% izolovanih starih u uzorku. Prosečan uzrast ispitanika pod rizikom je 77.5 (*SD* = 6.80) a van rizika 74.5 (*SD* = 6.30; $t(233) = 3.078$, $p < .01$). Ispitanici pod rizikom potiču iz manjih gradova i sela (66%), dok je najveći deo ispitanika koji nisu pod rizikom iz većeg grada (60%; $\chi^2(2) = 15.853$, $p <. 01$). Ispitanici pod rizikom u većem procentu žive sami (85%) u poređenju sa onima koji nisu pod rizikom (60%; $\chi^2(1) = 9.830$, $p <. 01$); a u pogledu bračnog statusa među rizičnima je značajno manje onih koji su u braku (20%) u poređenju sa ispitanicima van rizika (38%; $\chi^2(3) = 15.361$, $p < .01$). Nije bilo razlika po polu i stepenu obrazovanja.

Diskriminativnom analizom izdvaja se jedna značajna diskriminativna funkcija. Parametri izolovane diskriminativne funkcije prikazani su u Tabeli 3.

Tabela 3

Parametri izolovane diskriminativne funkcije

Svojstvena vrednost	Procent varijanse	Kanonička korelacija	Wilks λ	χ^2	*df*	*p*
.30	100	.48	.77	59.44	5	.000

Izvodi iz matrice strukture i standardizovani koeficijenti prikazani su u Tabeli 4. Izolovanu diskriminativnu funkciju možemo interpretirati kao sklop visokog zadovoljstva životom, niske depresivnosti i usamljenosti, visoke rezilijentnosti i visokog doživljaja smisla života.

Tabela 4

Rezultati diskriminativne analize razlika između osoba pod rizikom i van rizika od socijalne izolacije

Varijabla	Matrica strukture	Standardizovani koeficijenti
Usamljenost	-.77	-.57
Zadovoljstvo životom	.64	.27

Rezilijentnost	.60	.40
Depresivnost	-.54	-.06
Smisao života	.51	.27

U Tabeli 5 prikazani su centroidi grupa na dobijenoj diskriminativnoj funkciji. Grupa starih pod rizikom nalazi se na negativnom kraju funkcije, dok se grupa starih van rizika nalazi na pozitivnom kraju funkcije.

Tabela 5

Centroidi grupa na izolovanoj funkciji

Grupa	Centroid
Pod rizikom	-.87
Van rizika	.34

Diskusija

Cilj ovog istraživanja sastojao se u ispitivanju strukture razlika u blagostanju starih osoba koje su dobro integrisane u društvenu mrežu i onih koji su pod rizikom od socijalne izolacije. Percepcija obima i učestalosti kontakata, te emocionalne i instrumentalne podrške, merena skalom LSNS je jedna od najčešće korišćenih skala za detekciju socijalne izolacije kod starijih osoba. U skladu sa istraživačkim nalazima da su članovi porodice i prijatelji osnovne strukturalne dimenzije društvenih odnosa u starijoj populaciji (Berkman et al., 2000; Lubben, 1988), LSNS procenjuje prirodu i obim (veličinu, bliskost i učestalost konatakata) rodbinskih i prijateljskih veza i na osnovu toga detektuje rizik od socijalne izolacije. U našem uzorku detektovano je 28,1% starih osoba pod rizikom od socijalne izolacije. Prosečan skor na skali LSNS iznosi 16,39 što znači da stare osobe u proseku imaju do tri osobe u krugu prijatelja i porodice sa kojima redovno kontaktiraju, osećaju bliskost i mogu da računaju na njihovu pomoć. Ispitanici koji su detektovani kao rizični u pogledu socijalne izolacije pripadaju grupi starijih starih (preko 75 godina), potiču uglavnom iz manjih gradova ili sela, nemaju

supružnika, i u većem procentu žive sami. Nije bilo razlika po polu i stepenu obrazovanja između socijalno izolovanih i onih ispitanika koji nisu pod rizikom od socijalne izolacije.

Interkorelacije odabranih varijabli nam pokazuju da je socijalna mreža kod starih u pozitivnoj korelaciji sa životnim zadovoljstvom, smislom života, te rezilijentnošću, a u negativnoj relaciji sa depresijom i usamljenošću. Sve korelacije su stepena srednje povezanosti.

Pozitivni indikatori blagostanja međusobno pozitivno koreliraju. O povezanosti pozitivnih indikatora blagostanja svedoče i mnoga druga istraživanja. Pozitivne korelacije se beleže između smisla života i zadovoljstva životom (Arslan et al., 2021; Lin et al, 2020), dok su relacije rezilijentnosti i blagostanja naročito istraživane na uzorcima starih kao indikatori uspešnog starenja (Wagnild, 2003) i dosledno pokazuju povezanost rezilijentnosti i posebnih indikatora blagostanja (Di Fabio & Palazzeschi, 2015; Rowe & Kahn, 2000), kao i povezanost rezilijentnosti i ukupnog blagostanja kod starih (Ryff, 2014; Sayed et al., 2024; Smith & Hollinger-Smith, 2015). Rezultati dalje pokazuju da su usamljenost i depresivnost pozitivno međusobno povezane, a negativnu korelaciju ostvaruju sa životnim zadovoljstvom, smislom života i rezilijentnošću. Potvrdu naših rezultata nalazimo u istraživanjima koje beleže negativnu povezanost između zadovoljstva životom i depresije (Sun et al., 2020), te usamljenosti kod starih (Liu et al., 2021), dok se smisao života kod starih dosledno pokazuje kao važan protektivni faktor za depresiju (Volkert et al., 2014) i usamljenost (Macia et al., 2021). Rezilijentnost je takođe negativno povezana sa depresijom (Rodrigues & Tavares, 2021) i usamljenošću (Just et al., 2022).

Naša osnovna pretpostavka bila je da će, u poređenju sa starima koji imaju jaku socijalnu mrežu, stare osobe u riziku od socijalne izolacije imati niži stepen rezilijentnosti, smisla života i zadovoljstva životom, te povišenu depresivnost i osećanje usamljenosti. Rezultati istraživanja potvrdili su ove pretpostavke. Poređenjem dela uzorka starih koji su pod rizikom od socijalne izolacije i onih koji nisu, dobijena je jedna statistički značajna diskriminativna funkcija. Po statističkom kriterijumu korelacija većih od 0.30 izolovanu diskriminativnu funkciju definiše visoko zadovoljstvo životom, visoka rezilijentnost i smisao života, te niska depresivnost i usamljenost. Rezultati

pokazuju da grupa socijalno izolovanih starih ima statistički značajno niži nivo blagostanja u odnosu na grupu starih koji su dobro integrisani u socijalnu mrežu.

Rezultati ovog istraživanja potvrđuju nalaze koji sugerišu da su socijalni odnosi važna determinanta blagostanja u starosti. Veliki broj autora sugeriše povezanost socijalne izolacije sa nižim stepenom zadovoljstva životom (Chan et al., 2023; Clair et al., 2021; Kim & Park, 2024; Qi et al., 2022; Tomida et al., 2023), kao i to da struktura socijalne mreže, učestalost kontaktiranja i kvalitet odnosa unutar mreže jasno predviđaju osećanje smisla života kod starih (AshaRani et al., 2022, Pfund et al., 2022; Pinquart, 2002; Steptoe & Fancourt, 2019). Suženje socijalne mreže u starosti zbog svih razvojnih gubitaka (međuljudskih gubitaka, pogoršanja zdravstvenog statusa, te gubitaka uloga) sa sobom nosi smanjenje dostupnosti različitih vrsta socijalne podrške, što može biti povezano sa smanjenjem doživljaja smisla života i zadovoljstva (Bakhshandeh Bavarsad & Stephens, 2024). S druge strane, ima istraživanja koja pokazuju da je odnos između smisla života i jačine socijalne mreže recipročan (Stavrova & Luhman, 2016). Folker i saradnici (Folker et al., 2021) tako smatraju da smisao života promoviše pozitivnu orijentaciju ka drugima u smislu biranja i povezivanja sa ljudima slične orijentacije i na taj način prevenira usamljenost.

Naši rezultati potvrđuju i istraživanja koja nalaze pozitivne relacije između veličine društvene mreže te učestalosti kontaktiranja i stepena rezilijentnosti kod starih (Hildon et al., 2010; McKibbin et al., 2016; Park et al., 2021; Wells, 2010). Većina autora tvrdi da su jake socijalne mreže krucijalni protektivni faktor u suočavanju sa razvojnim i nerazvojnim stresorima u starosti.

Dobijeni rezultati su u skladu i sa istraživanjima koja pokazuju da uska socijalna mreža, odnosno mali broj socijalnih kontakata i niska učestalost kontakata predviđaju depresivne simptome kod starih (Cornwell & Laumann, 2015; Santini et al., 2020), odnosno da su jake socijalne mreže jedan od važnih protektivnih faktora za razvoj depresije kod starih (Bui, 2020; Luna et al., 2020; Wickramaratne et al., 2022). Iako longitudinalne studije na starima pokazuju da je veza između socijalne izolacije i depresije jednosmerna, u smislu da socijalna izolacija predviđa simptome depresije (Domènech-Abella et al., 2019), ima i tumačenja da ova relacija može biti i recipročna,

tako da depresivni stari snižavaju učestalost kontaktiranja sa osobama iz svog okruženja i na taj način sužavaju socijalnu mrežu (Bui, 2020). Slično važi i za relaciju između usamljenosti i socijalne izolacije. Iako se postojanje ove veze ne dovodi u pitanje (Chan et al., 2023; Kemperman et al., 2019; Kuru Alici & Kalanlar, 2021), smer povezanosti je još uvek nedovoljno jasan. Dok mnogi istraživači smatraju da je usamljenost izazvana socijalnom izolacijom (Dahlberg et al., 2018; Routasalo et al., 2006), jer nedostatak socijalnih kontakata, tj. strukturalne i funkcionalne podrške, vodi do percipirane socijalne izolacije i afektivnih poremećaja u starom dobu (Santini et al., 2015), ima i mišljenja da je relacija usamljenosti i socijalne izolacije recipročna (Domènech-Abella et al., 2019).

Iako na osnovu nacrta istraživanja ne možemo tvrditi ništa o smeru povezanosti, ipak smo bliži mišljenju autora koji smatraju da smer uticaja ide od strukturalno funkcionalnih karakteristika socijalnih mreža ka blagostanju, tj. da nedostatak socijalnih kontakata, te percepcija limitirane funkcionalne podrške predstavlja izvor i generator negativne spirale koja dalje može da vodi do sniženog blagostanja u starosti (Santini et al., 2015). Svakako, rezultati našeg istraživanja sugerišu da obim i učestalost kontakata sa članovima porodice i prijateljima, te percepcija emocionalne i instrumentalne podrške jesu važne odrednice blagostanja u starosti, što potvrđuje rezultate prethodnih istraživanja da strukturalno funkcionalne karakteristike socijalne mreže imaju povoljan uticaj na subjektivno blagostanje starih (Charles & Carstensen, 2010; Christakis & Fowler, 2013; Smith & Christakis, 2008). Socijalne mreže nude obilje kauzalnih puteva za uticaj na individualno blagostanje (Berkman et al., 2000). Jake socijalne mreže mogu uticati na blagostanje i zdravlje direktno (obezbeđivanjem različitih vrsta podrške), ali i indirektno - tako što ublažavaju nepovoljne efekte razvojnih i nerazvojnih stresora u starosti (Cohen, 2004; Thoits, 2011; Vonneilich et al., 2012). Kao važan mehanizam ovog uticaja ističe se osećanje sigurnosti ali i lične vrednosti, tj. percepcija osobe da je neko čuje, vidi i brine o njoj (Abramowska-Kmon & Timoszuk, 2020; Cohen, 2004; Uchino, 2004). Prema teoriji socioemocionalne selektivnosti, socijalne mreže starih postaju sve selektivnije i voljno se sužavaju u korist manjeg broja visokokvalitetnih bliskih odnosa koji doprinose blagostanju (Carstensen et al., 1999; Fung et al., 2008; Lang & Carstensen, 1994). Dodatno, zadovoljavanje osnovnih psiholoških potreba smatra se najjačim prediktorom blagostanja (Tang et al., 2020), te

potreba za povezanošću postaje naročito važna u starosti, kada opada stepen autonomije, i u tom smislu može imati i kompenzatornu ulogu.

S druge strane, može se pretpostaviti da su veze između socijalnih mreža i blagostanja u nekoj meri recipročne, što pokazuju i rezultati ranijih istraživanja. Tako na primer, depresivne i usamljene osobe mogu snižavati učestalost kontaktiranja sa osobama iz svog okruženja i na taj način sužavati mrežu kontakata i dostupnost socijalne podrške (Bui, 2020). Takođe, možemo pretpostaviti da se stare osobe koje su visoko rezilijentne, zadovoljnije svojim životom i imaju osećanje jasne svrhe u svom životu, percipiraju kao atraktivniji partneri za interakciju od strane članova socijalne mreže, te na taj način lakše stvaraju i održavaju socijalne kontakte.

Ipak, odgovor na pitanje šta je čemu uzrok je, pored empirijskog, i teorijsko pitanje, te naredna istraživanja treba da idu u pravcu daljeg povezivanja empirijskih nalaza sa teorijskim pretpostavkama, a kako bi se dobilo jasnije razumevanje smera povezanosti. Istraživanje eventualnih medijatorskih efekata odabranih varijabli bi takođe moglo doprineti boljem razumevanju relacija između ovih konstrukata. Na primer, neka istraživanja pokazuju da socijalna izolacija i usamljenost mogu nezavisno uticati na depresiju kod starih (Domènech-Abella et al., 2019; Houtjes et al., 2014), dok druga nalaze da usamljenost ima parcijalnu ili punu medijatorsku ulogu u odnosu između socijalne izolacije i depresije (Jin & Bae, 2023; Vasile et al., 2023). Slično tome, rezilijentnost se u nekim istraživanjima pokazuje kao medijator između socijalne izolacije i blagostanja kod starih (Qi et al., 202l). Bilo bi interesantno ispitati ulogu kvaliteta odnosa sa značajnim drugima u vezi socijalne izolacije i blagostanja starih, što bi omogućilo sveobuhvatniju procenu socijalnih mreža. To bi dodatno podržalo teoriju socioemocionalne selektivnosti, koja sugeriše da je sužavanje socijalne mreže u starosti rezultat namernog fokusa na manji broj visokokvalitetnih bliskih odnosa koji doprinose blagostanju (Carstensen et al., 1999; Fung et al.; 2001; Lang & Carstensen, 1994).

Ograničenja ovog istraživanja su svakako prigodan uzorak i oslanjanje isključivo na skale samoprocene. Ipak, vrednost ovog istraživanja ogleda se u potvrdi ranijih nalaza koji govore o tome da socijalna izolacija kod starih nije redak fenomen, te da možemo pretpostaviti da postoje snažne relacije između socijalne izolacije i sniženog blagostanja u opštoj populaciji starih.

Ovo je ujedno i prvo istraživanje kod nas koje se bavilo detekcijom rizika od socijalne izolacije kod starih i prvo u kome je upotrebljena skala LSNS koja je pokazala dobre metrijske karakteristike.

Praktične implikacije ovog istraživanja tiču se kreiranja psiholoških intervencija u oblasti socijalnog funkcionisanja starih. Postojeće intervencije mogu se svrstati u jednu od tri kategorije: one koje se eksplicitno fokusiraju na smanjenje socijalne izolacije (Chen & Shultz, 2016; Findlay, 2003), zatim intervencije koje su fokusirane na redukciju usamljenosti kod starih (Massi et al., 2011; Shekelle et al., 2024), te one koje uključuju i socijalnu izolaciju i usamljenost (Cattan et al., 2005; Fakoya et al., 2020; Poscia et al., 2018). Ipak, nedostatak socijalnih kontakata, strukturalne i funkcionalne podrške se smatraju osnovom koja dalje može da vodi do usamljenosti i afektivnih poremećaja u starom dobu (Santini et al., 2015), te se stoga insistira da prioritet treba dati promociji i unapređenju (povećanju) socijalnih kontakata među starima (Chen & Schulz, 2016; Holt-Lunstad et al., 2010). Iako ne postoje univerzalni pristupi koji bi bili odgovarajući za sve stare osobe (Fakoya et al., 2020), ono što se pokazalo ključnim za intervencije namenjene socijalno izolovanim starima je aktivna participacija, promocija socijalnih aktivnosti u grupi (npr. upoznavanje u svrhu širenja socijalne mreže, edukativne aktivnosti fokusirane na promociju kompetencija za održavanje i unapređenje socijalnih odnosa), te upotreba novih komunikacionih tehnologija (Cattan et al., 2005; Chen & Shultz, 2016; Dickens et al., 2011; Findlay, 2003; Gardiner et al., 2018). Takođe, pokazalo se da veću efikasnost imaju intervencije koje ciljaju određene grupe starih izolovanih pojedinaca (u domovima za stare, tugujući stari, i sl.). Ovim aktivnostima bismo pridružili edukovanje zajednice ali i članova porodičnih i prijateljskih mreža o stepenu važnosti redovnog održavanja kontakta sa starima kako bi se zadovoljila potreba za povezanošću i podrškom koja se pokazuje fundamentalnom za njihovo blagostanje.

Zaključak

Socijalna izolacija i usamljenost starih su prepoznate kao prioritetni svetski javnozdravstveni problem, te je Svetska zdravstvena organizacija unutar dekade zdravog starenja (2020-2030) ove fenomene stavila u prvi plan, vodeći se procenom da svaka četvrta stara osoba ima iskustvo

socijalne izolacije (WHO, 2021). Shodno tome, rani skrining socijalne izolacije postao je još važniji za oblast gerontopsihologije i kreiranje odgovarajućih preventivnih mera u praksi zdravstvene zaštite starijih osoba (Dickens et al., 2011; Lubben et al., 2006). Srbija je među evropskim zemljama s najvećim udelom starijih u stanovništvu (Penev, 2014), ali su istraživanja o starima i dalje retka. To je posebno izraženo u oblasti socijalnog života starijih, iako u svetu raste interesovanje za proučavanje njihovih socijalnih mreža i uticaja na psihološko i fizičko zdravlje (Valente, 2010). Jedno od retkih istraživanja ovog tipa u Srbiji pokazuje da stari imaju ređe kontakte sa članovima porodice nego stari u evropskim zemljama, dok je učestalost kontakata sa prijateljima ista (Babović i sar., 2018). Ovo istraživanje je pokazalo da 5% starih u Srbiji nema nikoga sa kim bi moglo da podeli svoje probleme, a gotovo petina nema osobu koja bi im pružila instrumentalnu pomoć (Babović i sar., 2018). U našem uzorku detektovano je 28,1% starih osoba pod rizikom od socijalne izolacije, što znači da gotovo svaka treća stara osoba u našem uzorku ima u proseku manje od dve osobe sa kojima održava redovan kontakt, oseća bliskost i na čiju pomoć može da računa. Rezultati ovog istraživanja potvrđuju neophodnost uvremenjene identifikacije starih osoba koje su socijalno izolovane, te osmišljavanja intervencija koje bi imale za cilj ojačavanje socijalnih mreža starih kako bi se unapredilo njihovo psihološko blagostanje.

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Social isolation and wellbeing in elderly

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ABSTRACT

The structural aspects of social networks serve as channels that facilitate social engagement and enable access to various forms of psychological support and instrumental assistance. Given that social networks tend to shrink and social support diminishes in old age, older adults are at particular risk of social isolation. Considering the potentially detrimental effects of social isolation on overall well-being in later life, this study aims to examine structural differences in well-being between older adults who are well-integrated into social networks and those at risk of social isolation. Well-being in older adults was assessed through life satisfaction (the cognitive component of subjective well-being), the absence of depressive symptoms and feelings of loneliness (as affective components of subjective well-being), meaning in life as an indicator of psychological well-being, and levels of resilience. The study included 294 participants, with an average age of 75 years (66% female), who completed the Lubben Social Network Scale (LSNS), the Satisfaction with Life Scale (SWLS-3), the Meaning in Life Questionnaire (MLQ), the Depression subscale from the DASS-21 scale, the De Jong Gierveld Loneliness Scale (DJGLS), and the Brief Resilience Scale (BRS). To address the research objective, a discriminant analysis was conducted. The results revealed that 28.1% of the older adults in the sample were at risk of social isolation. One significant discriminant function was identified, characterized by high life satisfaction, high resilience, and a strong sense of meaning in life, alongside low levels of depression and loneliness. The findings indicate that socially isolated older adults exhibit significantly lower well-being than those well-integrated into social networks, confirming that social relationships are a crucial determinant of well-being in old age.

Keywords: social network, well-being, social isolation, older adults

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Research Article

Is it about me or my partner's personality? Personality traits as correlates and predictors of jealousy in couples

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ABSTRACT

A high number of studies on romantic jealousy in heterosexual couples has accumulated in the past decades, including those intended to explain how this phenomenon relates to personality traits. This study aimed to advance current knowledge by using the HEXACO model supplemented by the Disintegration trait and presenting novel findings on how these traits in couples relate to their own and their partners' (cognitive, behavioral, and emotional) jealousy while also assessing traits' explanatory power for each aspect of jealousy. The HEXACO-PI-R Inventory, the DELTA-20 instrument, and the Multidimensional Jealousy Scale were administered to the sample of 400 heterosexual participants (200 couples dating or being married), and the correlations and the Actor-Partner Interdependence Model (APIM) were applied. As the APIM showed, both women and men tend to have higher levels of cognitive and emotional jealousy if they score lower on Honesty-humility. Women tend to achieve higher scores in cognitive and emotional jealousy if they score higher in Emotionality. Men tend to score higher in all aspects of jealousy if their partners score lower on Agreeableness. Low Openness in men may contribute to behavioral jealousy in women, while high Disintegration in women could facilitate the development of emotional jealousy in men. In general, the effects of a partner's personality traits on jealousy in women were weaker compared to the effects on jealousy in men.

Keywords: Jealousy, HEXACO, Disintegration, Couples

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Introduction

Jealousy

Jealousy is a phenomenon inherent to humans, probably as old as humanity, which tends to occur in many forms, including jealousy in couples (also referred to as "romantic" jealousy), friendship, professional context, siblings' jealousy, and jealousy among parents respective of their relations with children. Out of these, jealousy in couples – which is the focus of our work – is one of the most explored forms, especially in a heterosexual context. As defined by Pfeiffer and Wong (1989), jealousy is a complex set of emotions, cognition, and behavior. The emotional aspect of jealousy refers to feelings of insecurity, fear, or anger that arise as a response to a perceived threat to the relationship, which can be either actual or suspected, but in any case, includes the third person (a rival). Cognitive jealousy includes ruminative and intrusive thoughts related to the rival's interest in the partner and the partner's interest in the rival. At the behavioral level, jealousy manifests in various ways, including surveillance of the partner and attempts to control and restrict the partner's behavior, involving a confrontation with the third person in some cases. Unlike some other scholars differentiating between normal and pathological jealousy (see Marazziti et al., 2003; Seeman, 2016), Pfeiffer and Wong (1989) do not make such a strict delineation; instead, they see jealousy as a continuum. From their point of view, each of the three aspects of jealousy could take an extreme form. However, while low to moderate levels of emotional jealousy could be considered normal, high levels of emotional jealousy, usually coupled with moderate or high levels of cognitive and behavioral jealousy, are likely to indicate pathological levels of jealousy. Of course, Pfeiffer and Wong (1989) were not the only ones who defined the structure of jealousy and proposed a corresponding model. Buunk (1997) also offered a dimensional model of jealousy comprising reactive, anxious, and possessive jealousy. From his standpoint, reactive jealousy is a response to the real threat (e.g., a partner showing interest in someone else), anxious jealousy is a tendency to be worried and suspicious about potential threats, even if there is no actual reason, while possessive jealousy is the manifestation of the desires to control the partner and prevent any possible threats. Some of the

dichotomous views on the nature of jealousy were also proposed. For instance, Parrott (1991) proposed the division into suspicious jealousy, which arises as a response to a possible threat, and *fait accompli* jealousy, which is a response to infidelity that has already occurred. Moreover, Rich (1991) offered the division into jealousy as a state (provoked by the actual threat) and jealousy as a disposition (i.e., a tendency to develop jealous responses irrespective of the actual threat).

Jealousy in couples is mainly viewed in a negative light, as there is evidence that it is related to decreased relationship satisfaction (Kılıç & Altınok, 2021) and quality (Barelds & Barelds-Dijkstra, 2007) and increased relationship conflicts that may result in violence (Kyegombe et al., 2022). However, jealousy in emotional relationships between partners does not necessarily need to be a negative phenomenon, especially if not exaggerated. As Attridge (2013) reported, satisfaction with a relationship relates negatively to cognitive jealousy but positively to emotional jealousy. Such a finding corroborates the postulates of the evolutionary framework (Buss & Haselton, 2005). As explained by Buss and Haselton (2005), jealousy is an evolved adaptation activated by the threat to a valuable relationship, and it has a purpose to protect it from the possible reproductive consequences of infidelity. Further, they elaborated on the sex/gender differences, indicating that men are more likely to be triggered by the cues of sexual infidelity and distressed by threats from rivals with more resources (seen as a threat to paternity certainty). Women, on the other hand, tend to be more upset by the possibility of emotional infidelity (seen as a threat to the partner's commitment), especially if the rival is more physically attractive. These considerations received empirical support, as other scholars showed that women tend to score higher than men on emotional and behavioral jealousy (e.g., Elphinston et al., 2011; Zandbergen & Brown, 2015).

Guerrero and Andersen (1998) have offered the componential model as one of the theoretical and descriptive frameworks for understanding romantic jealousy. According to this model, the perception of a threat to the valued relationship generates jealous cognitions and emotions that shape communicative responses (i.e., behavior). Consequently, communicative responses impact relational outcomes such as satisfaction and stability. The entire process is framed by six so-called "antecedent" factors: socio-

biological, cultural, personality, relational, situational, and strategic. Socio-biological factors, viewed through an evolutionary lens, suggest jealousy serves as a mechanism for mate retention, with gender differences as previously described. Cultural factors influence how jealousy is experienced and expressed, with norms varying across societies – some see jealousy as a sign of love, while others view it negatively. Regarding personality factors, the authors argue that individual differences, such as personality traits or attachment styles, influence how jealousy is experienced. For instance, individuals with high trait anxiety or insecure attachment styles may be more prone to intense jealous feelings and maladaptive responses. These personal dispositions shape the cognitive and emotional components of jealousy, influencing both the perception of threats and the subsequent emotional and behavioral reactions. Relational factors, such as satisfaction and commitment, can either mitigate or heighten jealousy, depending on the strength of the relationship. Situational factors refer to specific events or contexts that trigger jealousy, like seeing a partner interact with a potential rival. Finally, strategic factors encompass how individuals manage jealousy and may range from constructive problem-solving to destructive confrontation, depending on the relational goals.

The componential model offers a comprehensive description of the factors that influence jealousy at the individual level, including the role of personality. However, this model does not underscore that individual outcomes inherent to romantic relationships, such as jealousy, can be influenced not only by individuals' own but also by their partners' personality traits. Other researchers interested in personal relationships tested this assumption. For instance, Caughlin et al. (2000) examined the connections between marital satisfaction and personality traits in married couples and proposed two models. The first one is the intrapersonal model, which assumes that an individual's marital satisfaction is directly influenced by their own personality traits. The second one is the interpersonal model, which assumes that the personality traits of one person, as they generate corresponding behavior, influence another person's marital satisfaction. Their study provided support for both models, which can also be applied to jealousy. These two models are complementary and provide a valuable explanation of how one person's personality might influence their own and

partner's outcomes. However, this framework does not account for the interdependence in couples.

To the best of our knowledge, the Actor-Partner Interdependence Model (APIM; Kenny et al., 2006) is the most comprehensive framework for examining dyad-level outcomes because it encompasses the intrapersonal model, interpersonal model, and interdependence. The APIM is an analytic framework based on interdependence theory (Kelley & Thibaut, 1978), which posits that functioning in close relationships is dynamic and reciprocal in nature, meaning that the thoughts, feelings, and behaviors of two coupled individuals are interconnected. The APIM relies on a dyadic perspective, meaning that couples are considered the unit of analysis and account for both intrapersonal and interpersonal effects (i.e., actor effect and partner effect). Besides, the APIM can be a useful tool to estimate not only the actor and partner effects in couples but also the differences in strength of these effects for dyad members. For instance, Robins et al. (2000) reported that both women's and men's personality traits have actor and partner effects on their perceptions of relationship quality, with the actor effect being stronger in women. This model has been widely used in research on romantic relationships and applied to a variety of outcomes such as relationship satisfaction (Conradi et al., 2017), relationship quality (Barelds & Barelds-Dijkstra, 2007), mate retention behaviors (Kardum et al., 2019), marital stability (He et al., 2018), marital satisfaction (Stroud et al., 2010), and romantic jealousy (Brauer et al., 2021).

Personality and jealousy

Personality traits are usually considered to have an important role in one's behavior, emotions, and cognition. The HEXACO (Lee & Ashton, 2004) is one of the comprehensive models of personality, encompassing six basic traits: Extraversion, Emotionality, Agreeableness, Conscientiousness, Openness to experience, and Honesty-humility. Extraversion refers to the tendency to feel confident, enjoy social gatherings, and experience positive feelings. Emotionality depicts the proneness to experience fear of physical danger and anxiety in response to life stressors, accompanied by elevated empathy, sentimental attachment to others, and a need for emotional support. Agreeableness refers to the proneness to forgive others for their

wrongdoing, being lenient in judging them, willingness to compromise and cooperate with others, and having a high ability to control own temper. Conscientiousness corresponds to tendencies to be organized, self-disciplined, accuracy- and perfection-seeking, and careful in decision-making. Openness represents proneness to enjoy the beauty of art and nature, be imaginative in everyday life, be inquisitive about knowledge, and be interested in unusual ideas and people. Lastly, Honesty-humility refers to tendencies to avoid manipulating others, to have little interest in wealth and luxuries, and to feel no special entitlement to social status (Ashton & Lee, 2008; Lee & Ashton, 2020). The HEXACO model is similar to the traditional Big Five model (Goldberg, 1990), which includes Extraversion, Neuroticism, Agreeableness, Conscientiousness, and Openness to experience. Moreover, it could be seen as its extension because they are both based on the lexical approach, and there is a substantial overlap in their content. However, the HEXACO model includes Honesty-humility as a unique factor that emerged as the sixth factor in early studies on the Big Five traits space. Even though the HEXACO model can be considered to have some advantages over the Big Five (see Ashton & Lee, 2007), none of the two models includes proneness to psychotic-like experiences, which are equally important for one's cognitions, emotions, and behavior in everyday life. For that reason, Knežević et al. (2017) proposed the Disintegration trait, which reflects the disturbances in emotional, behavioral, and cognitive regulation (e.g., the tendency to see connections between seemingly unrelated phenomena). It was shown that both the Big Five (Knežević et al., 2016; Knežević et al., 2017) and the HEXACO (Knežević, Lazarević, Bosnjak, et al., 2022) models can be supplemented by Disintegration trait, which leads to a more comprehensive assessment of personality and increases the predictive power of personality traits (see Lazarević et al., 2021; Lukić & Živanović, 2021; Nedeljković & Topalović, 2023; Stanković et al., 2022).

Over the decades of exploring jealousy, some researchers opted to examine how jealousy relates to personality traits. However, the empirical literature in this field is relatively limited. To the best of our knowledge, the HEXACO model has not been used in this setting. Previous endeavors were mainly focused on the Big Five model and considered the personality–jealousy nexus as an intrapersonal process, but they provided valuable knowledge. As shown by previous studies, jealousy is likely to be higher in people high in Neuroticism and those low in Agreeableness (see Gubler et al.,

2023; Richter et al., 2022), which stands as one of the most robust associations when it comes to personality traits. Although the data regarding the other personality traits encompassed by traditional five-factorial models are not entirely consistent, Conscientiousness might also be relevant in understanding jealousy in couples. As Dijkstra and Barelds (2008) reported, low Conscientiousness in one partner is predictive of their own and their partners' jealousy. There are also some findings on the relationship between jealousy and the Dark Triad traits (i.e., Machiavellianism, narcissism, and psychopathy), which are relevant for the Honesty-humility domain due to the substantial overlap between the negative pole of this trait and the Dark Triad construct (see Dinić et al., 2018; Dinić & Wertag, 2018). It has been shown that the Dark Triad relates positively with jealousy (Barelds et al., 2017; Burtăverde et al., 2021; Chin et al., 2017). The individuals high in the Dark Triad are not just more likely to be afraid of and anticipate the infidelity of their partners, but they are also more prone to engage in infidelity behaviors (March et al., 2023; Lișman et al., 2023). Although no studies considered Honesty-humility in the context of jealousy, some findings indicate that low scores on this trait can play an important role in a dyad setting. For instance, as Reinhardt and Reinhard (2023) reported, persons who score low in this trait tend to be less committed and less close to their partners while being more dishonest in the existing relationship (e.g., lying to their partners more frequently). Further on, psychotic features could also have a role in jealousy. A positive relationship between jealousy and psychoticism was found in the non-clinical population (Sheikhmoonesi et al., 2020), while schizophrenia-spectrum disorders are characterized by a high prevalence of delusional jealousy (Soyka & Shmidt, 2011).

Current study

Previous research has provided valuable insights into the association between personality and jealousy. However, those studies have primarily focused on five-factor models and have mainly neglected possible differences in how personality traits in women/men relate to their partner's jealousy. Therefore, the objective of this study is twofold: firstly, to expand the knowledge on the personality–jealousy nexus by applying the HEXACO model supplemented with the Disintegration trait, and secondly, to investigate how jealousy in couples relates to their own and partner's

personality traits, and to what extent own and partner's traits can explain jealousy. We assumed that jealousy would demonstrate positive associations with Emotionality and Disintegration while exhibiting negative relationships with Agreeableness and Honesty-humility – the same pattern for both women and men. This is a general expectation when it comes to how one's jealousy could relate to their own personality, and it is based on previous findings (e.g., Barelds et al., 2017; Gubler et al., 2023; Richter et al., 2022; Sheikhmoonesi et al., 2020). Additionally, we hypothesized that jealousy in both women and men would be related negatively to their partners' Honesty-humility. Previous studies showed that individuals who score low on Honesty-humility tend to be more dishonest in actual romantic relationships and display lower levels of commitment and closeness (Reinhardt & Reinhard, 2023). Hence, it is reasonable to assume that their partners can perceive these characteristics as a cue of interest in another person, which might provoke jealousy. Finally, we hypothesized that individual differences in jealousy in women could be, to a greater extent, attributed to their own personality traits compared to jealousy in men, while not having a specific hypothesis about the amount of variance of jealousy in women and men explained by personality traits of their partners. This hypothesis is explorative; however, it has some foundation. First, women tend to score higher on emotional and behavioral jealousy (see Elphinston et al., 2011; Zandbergen & Brown, 2015). Second, they also tend to score higher on the Emotionality trait (Lee & Ashton, 2020), meaning they are more prone to experiencing anxious feelings and developing sentimental attachment to others. In the context of a romantic relationship, this might be seen as favorable for developing jealousy. Third, as Robins et al. (2000) reported, the effect of own personality on perceived relationship quality was shown to be stronger in women compared to men. This is a piece of evidence that the effect of own personality on some dyad-level outcomes might be stronger in women.

Method

Participants and procedure

The sample comprised 400 heterosexual participants: 200 women (*M*age = 27.05, *SD*age = 6.29, min = 19, max = 47) and 200 men (*M*age = 29.35, *SD*age = 6.87, min = 20, max = 52). The sample included couples who

were dating (*N* = 151) or being married (*N* = 49) for at least one year (*M* = 3.91, *SD* = 2.81, max = 15) to ensure that patterns of behavior and communication inherent to each couple were already more or less developed. The data was collected using the *Google Forms* platform, and the survey was distributed through social networks, mailing lists, and authors' personal contacts. Participation in the survey was anonymous, voluntary, and without any compensation. The data were merged using the unique codes created by each couple, which comprised a combination of the last two digits of their phone numbers and the first letters of their mothers' names. Participants were asked to fill out the survey independently of their partner and to abstain from discussing their answers and influencing their partner's responses in any way. The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments.

Measures

HEXACO-60

HEXACO-60 (Ashton & Lee, 2009; for Serbian translation, see Međedović et al., 2019) was used to assess Honesty-Humility (e.g., "*I wouldn't pretend to like someone just to get that person to do favors for me*"), Emotionality (e.g., "*I sometimes can't help worrying about little things*"), Extraversion (e.g., "*On most days, I feel cheerful and optimistic*"), Agreeableness (e.g. "*I rarely hold a grudge, even against people who have badly wronged me*"), Conscientiousness (e.g., "*I plan ahead and organize things, to avoid scrambling at the last minute*"), and Openness (e.g., "*People have often told me that I have a good imagination*"). Each domain was assessed by 10 items, administered with a 5-point scale (from 1 = *strongly disagree* to 5 = *strongly agree*).

DELTA-20

DELTA-20 instrument (Knežević et al., 2017) was used to estimate the Disintegration trait, which reflects the tendency toward experiencing psychotic-like phenomena characterized by cognitive and perceptual disruptions, emotional instability, and disorganized thinking. It comprises 20 items (e.g., "*People speak ill of me*"), administered with a 5-point scale (from 1 = *strongly disagree* to 5 = *strongly agree*).

The Multidimensional Jealousy Scale (MJS)

The Multidimensional Jealousy Scale (MJS; Pfeiffer & Wong, 1989; for Serbian translation, see Tošić-Radev & Hedrih, 2017), a 24-item measure, was used to assess cognitive, behavioral, and emotional jealousy aspects, previously described in the Introduction. In assessing cognitive and behavioral aspects, participants respond how often they have specific thoughts about their partners (e.g., "*I suspect that my partner may be attracted to someone else*") and how often they engage in certain behaviors (e.g., "*I question my partner about his/her telephone calls*") using a 5-point response scale (from 1 = *never* to 5 = *all the time*). In assessing the emotional aspect, participants evaluate their emotional experiences in specific situations (e.g., "*My partner smiles in a very friendly manner to someone of the opposite sex*") using a 5-point response scale (from 1 = *very pleased* to 5 = *very upset*). Each aspect was measured by 8 items.

The scores were calculated as the mean of responses on corresponding items.

Data analysis

Before examining the associations between the variables of our interest, we computed basic desciptives (means and standard deviations) of personality and jealousy scales and their reliabilities for women and men and examined gender differences. We calculated Pearson correlations to get the fundamental insight into how personality traits and jealousy in women and men relate to their own and their partners' jealousy. To estimate the effects of personality traits on jealousy in couples, we applied the APIM framework. The analyses were performed by an online tool, APIM_MM, which estimates the APIM using multilevel modeling (Lederman et al., 2019). In this approach, the actor effects (one's jealousy regressed to their own personality traits) and the partner effects (one's jealousy regressed to their partner's personality traits) are estimated for women and men separately, whereas the dyad is taken into account at the first level of the model (women and men are nested into dyads). The APIMs for cognitive, behavioral, and emotional jealousy were controlled for relationship type and duration (included as dyad-level covariates).

Results

As displayed in Table 1, all the scales produced satisfactory levels of reliability (α > .70), except for the Emotionality dimension, where alpha values were somewhat lower in both genders. The differences in personality traits and jealousy were observed. Women displayed higher Emotionality, Openness, and Honesty-humility, and higher levels of the three aspects of jealousy compared to men. These differences ranged between small and medium in magnitude, except for Emotionality, where the difference was large (Cohen's *d* values of around .20, .50, and .80 or higher are considered as small, medium, and large effects, respectively; for details, see Sullivan & Feinn, 2012).

Table 1

Means, standard deviations, reliabilities, and gender differences between the variables

	Women		Men			
	M (SD)	α	*M (SD)*	α	*t*	*d*
Extraversion	3.24 (0.69)	.76	3.36(0.66)	.71	1.87	.13
Emotionality	3.69 (0.59)	.67	2.71 (0.60)	.64	15.65**	1.11
Agreeableness	2.90 (0.68)	.73	2.87 (0.68)	.72	0.33	.02
Conscientiousness	3.65 (0.67)	.77	3.57 (0.70)	.79	1.15	.08
Openness	3.81 (0.71)	.77	3.65 (0.80)	.79	2.53*	.18
Honesty-humility	3.76 (0.66)	.69	3.45 (0.80)	.76	4.82*	.34
Disintegration	2.26 (0.72)	.88	2.18 (0.71)	.89	1.38	.10
Cognitive jealousy	1.94 (0.80)	.88	1.74 (0.66)	.85	3.54*	.25
Behavioral jealousy	1.78 (0.60)	.76	1.52 (0.55)	.77	5.13*	.36
Emotional jealousy	3.55 (0.77)	.84	3.29 (0.96)	.90	3.41*	.24

Note. d = Cohen's measure of the effect size

* $p < .05$. ** $p < .01$.

In line with our aims and hypotheses, we first applied the correlation analysis to examine how the three aspects of jealousy in women and men relate to their own and their partners' personality traits (see the Appendix).

We will first introduce the associations between jealousy and own personality traits. Cognitive, behavioral, and emotional jealousy in women was associated with their high Emotionality and Disintegration and low Agreeableness – those were the correlations indicating a consistent pattern of relationships between specific traits and all three aspects of jealousy. Further inspection of the correlations indicated that cognitive and behavioral jealousy in women relate negatively to their Honesty-humility, while this trait was not associated with the emotional aspect. Cognitive jealousy in women correlated negatively with their Emotionality and Conscientiousness, while the behavioral component achieved a negative (although weak) correlation with Openness. In men, Honesty-humility was the only trait that produced systematically negative associations with all jealousy aspects. Among the other traits, Agreeableness in men was associated with their behavioral jealousy and Openness with their emotional jealousy – both negatively. In men, Extraversion, Emotionality, Conscientiousness, and Disintegration remained unrelated to their jealousy.

The following step was to analyze how jealousy relates to a partner's personality traits. In women, cognitive and behavioral jealousy were related in the same way to a partner's traits – negatively to Openness and Honesty-humility and positively to Disintegration. However, the emotional aspect of jealousy in women turned out to be entirely unrelated to the partner's personality traits. In men, the three aspects of jealousy were found to relate negatively to their partners' Agreeableness only; the behavioral aspect was negatively associated with partners' Conscientiousness, while cognitive and emotional jealousy aspects were found to be positively associated with partners' Disintegration.

Correlations between women's and men's personality traits were mostly non-significant; the highest correlation was between their Disintegration (r = .33, p < .01). All aspects of jealousy in women aspects correlated positively with all aspects of jealousy in men (from r = .14, p < .05 between women's behavioral jealousy and men's emotional jealousy, to r =

.43, $p < .01$ between women's cognitive jealousy and men's cognitive jealousy). For a detailed review, see the Appendix.

As introduced in the Data Analysis section, we estimated three APIMs, one for each jealousy aspect. The estimates of actor and partner effects from the APIMs are displayed in Table 2.

Table 2

Standardized regression coefficients for actor and partner effects of personality traits on jealousy based on APIMs

	Cognitive		Behavioral		Emotional	
Predictor	actor (β) W→W M→M	partner (β) M →W W→M	actor (β) W→W M→M	partner (β) M →W W→M	actor (β) W→W M→M	partner (β) M →W W→M
Extraversion	–.11 .00	–.05 –.08	–.00 –.06	–.04 –.00	.01 –.11	–.04 .04
Emotionality	.19* .05	–.06 –.00	.13 –.06	–.01 .02	.17* .10	–.03 –.06
Agreeableness	–.10 –.06	.08 –.20*	–.10 –.18*	–.01 –.21*	–.11 –.04	.13 –.19*
Conscientiousness	–.10 –.05	.08 –.04	–.02 .10	.02 –.17*	–.07 .12	.10 .09
Openness	.18* –.08	–.13 .08	–.03 –.01	–.15* .03	–.06 –.09	–.08 –.13
Honesty-humility	–.18* –.16*	–.18* .06	–.29** –.14*	–.09 .05	–.02 –.17*	–.09 .25**
Disintegration	.13 –.06	.07 .11	.00 .05	.08 –.00	.06 –.06	.11 .24**

Note. W = women; M = men; β = standardized regression coefficient.

* $p < .05$. ** $p < .01$.

The APIM for cognitive jealousy ($\chi^2_{30} = 74.05$, $p < .001$) showed that own and partners' personality traits account for a greater proportion of variance in the criterion for women ($R^2 = .18$) compared to men ($R^2 = .07$), controlling for covariates. On the other hand, the APIM for behavioral jealousy ($\chi^2_{30} = 97.86$, $p < .001$) showed that own and partners' personality traits

explain a negligibly greater proportion of variance in the criterion for women (R^2 = .17) compared to men (R^2 = .15), controlling for covariates. Similarly, the APIM for emotional jealousy (χ^2_{30} = 66.24, p < .001) showed that own and partners' personality traits explain approximately equal levels of variance in the criterion for women (R^2 = .07) and men (R^2 = .06), controlling for covariates.

In women, Emotionality was found to be predictive of the higher levels of cognitive and emotional aspects of their jealousy, Honesty-humility negatively predicted the cognitive and behavioral aspects, and Openness was found to be predictive of higher levels of cognitive jealousy only. The only significant partner effects on jealousy in women were the negative effects of men's Openness on behavioral jealousy and Honesty-humility on cognitive jealousy.

For men, the Honesty-humility trait was found to be the most predictive, as it was shown to predict lower levels of all three aspects of their jealousy. Another significant trait in men was Agreeableness, which was found to predict their low behavioral jealousy. When it comes to partner effects on men's jealousy, high Disintegration and Honesty-humility in women were predictive of emotional jealousy, low Conscientiousness was predictive of behavioral jealousy, while all three aspects were negatively predicted by Agreeableness.

Discussion

In this study, we aimed to shed light on connections between the three aspects of jealousy and personality traits framed under the model encompassing HEXACO and Disintegration, proposed as a seven-factor model (Knežević, Lazarević, Bosnjak, et al., 2022). As we employed correlations and the APIM, we will focus mostly on the effects that were confirmed at the dyad level.

The most remarkable differences were observed for cognitive jealousy, where own and partners' personality traits explained 18% of the variance in women and 7% in men. In women, this aspect of jealousy was predicted by their high Emotionality and Openness, low Honesty-humility, and their partners' low Honesty-humility. In men, however, cognitive jealousy was predicted only by their low Honesty-humility and their partners' low

Agreeableness. Hence, it is plausible to note that cognitive jealousy in women can be attributed to a greater extent to their own personality traits. Even though the design of the study does not allow these effects to be interpreted as causal, we can still offer some speculative and theoretical interpretations of possible influence. People who score low on Honesty-humility can be described as self-centered, and if their partners are not fully committed to them, that may provoke jealous thoughts. Such a tendency might be amplified in women if they score high on Emotionality because high scores indicate proneness to worrying and experiencing anxiety. On the other hand, the positive effect of Openness on jealous thoughts might seem surprising at first glance. However, after considering the content of the Openness trait, this effect becomes less surprising. Among other descriptors, Openness encompasses imaginative thinking, which could facilitate cognitive jealousy in women, especially if they score higher on Emotionality and are paired with men who score low on Honesty-humility. The effect of a partner's low Honesty-humility on cognitive jealousy in women is quite straightforward. As Reinhardt and Reinhard (2023) reported, individuals with low scores in Honesty-humility are more inclined to be dishonest in emotional relationships and usually display lower levels of commitment and closeness. Of course, such characteristics and behaviors in men may facilitate jealous thoughts in their partners.

Regarding behavioral jealousy, there was almost no difference between women and men in the amount of variance explained by personality traits (17% in women and 15% in men). However, the effects of personality traits on this aspect were quite different between women and men, with the exception of the already discussed negative actor effect of Honesty-humility in both genders. The partner's low Openness was predictive of behavioral jealousy in women. Individuals who score low on Openness are usually expected to be "closed-minded" (see Kashima et al., 2017; Knežević, Lazarević, Međedović, et al., 2022; Kruglanski, 2013), meaning they are likely to have conservative and traditional attitudes in general, including their views of social roles and related behaviors. Specifically, in men, this might include, for instance, going out and socializing with female friends while resenting such behavior in their partners and trying to impose "appropriate" behavior. Consequently, this may induce a jealous response in women. As we already mentioned, there is a reasonable overlap between the negative pole of

Honesty-humility and the Dark Triad traits (see Dinić et al., 2018; Dinić & Wertag, 2018), which have been studied in the context of relationship dynamics and mating strategies. Studies have shown that individuals who tend to score high in the Dark Triad usually have a higher number of sexual partners (Borráz-León & Rantala, 2021), a greater preference for short-term mating (Tucaković et al., 2022), and are more prone to infidelity (March et al., 2023; Lişman et al., 2023). Given this, men with low Honesty-humility might display at least some cues of interest in extra-dyadic relationships, if not actual infidelity. Hence, this may provoke jealousy in their partners. On the other hand, it seems that behavioral jealousy in men, related to low Agreeableness and Conscientiousness of their partners, could be explained in an entirely different way. The behavior associated with low scores on these two traits in women can be described as temper-driven and unpredictable – characteristics that their partners might perceive as a lack of commitment and a threat to the relationship, and that might facilitate monitoring behaviors in men. Although there is not much research on dyad-level associations, Seiffge-Krenke and Burk (2015) found in adolescent couples that non-constructive conflict resolution (i.e., psychologically and physically aggressive) in females relates positively to their male partners' jealousy. Hence, rebellious and disobedient acts in women are more likely to trigger jealous behavior in men than *vice versa*. However, it remains quite challenging to discern the actual reason for the difference we found.

Emotional jealousy produced somewhat different connections with personality traits compared to the previously discussed cognitive and behavioral aspects in terms of significant predictors in the APIM. However, an approximately equal amount of variance in this criterion was explained by personality traits (7% in women and 6% in men). Our results showed that women tend to experience higher levels of emotional jealousy if their "personality profile" is characterized by higher Emotionality, which is the only significant effect of all possible actor and partner effects. From a theoretical perspective, this result is not surprising. Women are indeed more prone to developing emotional jealousy (Buss & Haselton, 2005), and their emotional vulnerability (i.e., high Emotionality) might be one of the main factors contributing to jealous feelings, irrespective of whom they are coupled with. In men, emotional jealousy was predicted by their own low Honesty-humility, which is a reasonable effect that has already been discussed. However,

emotional jealousy in men was also predicted by their partner's high Disintegration and Honesty-humility and low Agreeableness. The partner effect of low Honesty-humility has already been addressed as well. Still, the partner effect of Disintegration on men's emotional jealousy is unique and needs clarification. Previous studies have shown that Disintegration is related to proneness to intuitive and irrational thinking (Purić & Jokić, 2023) and insecure attachment (Stanković et al., 2022). Along with low Agreeableness, these characteristics in women may contribute to an atmosphere of mistrust and insecurity, which might provoke a jealous emotional response in men. However, the positive partner effect of women's Honesty-humility on emotional jealousy in men is quite challenging to understand; moreover, it is atheoretical and could be seen as a statistical artifact.

Although novel and important findings are presented, some important limitations of the study need to be noted. The sample was not representative of the general population, limiting the generalizability of the findings. While the APIM is widely considered the best choice for analyzing dyadic data, it is important to note that many significant associations observed in the correlation analysis were not supported by the APIMs (i.e., they turned into non-significant effects). This is a consequence not only of partners' interdependence but also of the high number of variables included in the model. Therefore, some of these connections should not be discarded easily; rather, they should be further examined in future studies. As mentioned, the design of our study does not allow us to claim causality; instead, our interpretations of the findings should be seen as theoretical speculations about potential influence, providing pathways for future research and justifying further examination of personality–jealousy connections. Future studies are needed to thoroughly explain the relationships our study revealed and to better understand the nature of these connections. These future efforts should primarily focus on longitudinal designs, though some cross-sectional studies are also desirable. For instance, it would be beneficial to include partner-assessments (i.e., observer-reports) of jealousy alongside the self-assessments we applied.

Conclusion

Our study significantly contributed to the empirical literature on the relationships between jealousy and personality traits, pointing to the novel findings about (i) how jealousy in partners relates to their traits and (ii) how jealousy in women/men relates to their partner's traits, (iii) the extent to which the three aspects of jealousy can be explained by the HEXACO traits and Disintegration, and (iv) the most substantial differences. According to the APIM, cognitive, behavioral, and emotional jealousy in women was shown to be more strongly related to their own than their partners' personality traits. Their Emotionality emerged as a unique predictor of their cognitive and emotional jealousy, while it was not even associated with any aspect of jealousy in men nor with a partner's jealousy in either women or men. Therefore, it seems that high Emotionality in women – but not in men – amplifies the proneness to develop jealousy. On the other hand, womens' low Honesty-humility was a significant predictor of their cognitive and behavioral jealousy. This indicates that women tend to develop higher levels of jealousy if they are more self-centered and emotionally vulnerable, whereas partners' influence is relatively weak. Unlike women, all aspects of jealousy in men were predicted by their low Honesty-humility and their partners' low Agreeableness. Hence, it can be concluded that the partner effect is somewhat stronger on men's jealousy.In sum, we can draw some conclusions with regard to similarities and differences by looking back at the most stable findings. Both women and men tend to be more jealous if they score low on Honesty-humility. This proneness is likely to be amplified in women if they score high on Emotionality and in men if their partners score low on Agreeableness. The findings we highlighted have some practical implications. These insights can be beneficial in psychotherapy and counseling related to relationship problems revolving around jealousy. Specifically, some interventions can be reorganized to be gender-specific and more effective. For women, interventions should focus more on their emotional vulnerability. For men, interventions should focus more on communication strategies, which could help reduce the effect of their partners' Agreeableness.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data used in this paper are available upon a reasonable request.

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Appendix

Table A1

Intercorrelation matrix for personality traits and jealousy aspects in women and men

	Women										Men									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Women																				
1. Ex (w)	-																			
2. Em (w)	−.28**	-																		
3. Ag (w)	.09	−.18**	-																	
4. Co (w)	.10	−.09	.01	-																
5. Op (w)	.14	.19**	.13	.02	-															
6. Ho (w)	−.03	−.05	.23**	.14*	.10	-														
7. Di (w)	−.32**	.20**	−.12	−.20**	.14*	−.28**	-													
8. CJ (w)	−.14*	.24**	−.20**	−.19**	.04	−.27**	.31**	-												
9. BJ (w)	−.05	.22**	−.23**	−.12	−.15**	−.33**	.18**	.56**	-											
10. EJ (w)	−.11	.26**	−.18**	−.11	−.13	−.11	.15**	.40**	.38**	-										
Men																				
11. Ex (m)	.00	.07	.04	.08	.01	.06	−.16**	−.05	−.06	−.06	-									
12. Em (m)	.01	−.11	.09	−.01	.20**	.02	.02	−.05	−.05	−.06	−.10	-								
13. Ag (m)	.08	−.05	−.04	.07	.02	−.02	−.17**	−.05	−.08	.10	.09	−.04	-							
14. Co (m)	.03	−.05	.05	−.03	−.06	−.15**	−.01	−.03	−.02	.03	−.15**	−.09	−.12	-						
15. Op (m)	−.04	−.23	.08	.12	.25**	.05	−.13	−.18**	−.22**	−.11	−.07	.11	.14*	−.05	-					
16. Ho (m)	−.14*	−.07	.10	.10	.09	.24**	−.06	−.24**	−.23**	.03	−.08	.02	.27**	.06	.16**	-				
17. Di (m)	−.17**	.09	−.15**	−.03	.02	−.02	.33**	.16**	.14*	.10	−.33**	.23**	−.18**	−.36**	.10	−.28**	-			
18. CJ (m)	−.11	.10	−.22**	−.10	−.03	−.06	.19**	.43**	.26**	.24**	−.00	.01	−.13	−.06	−.14	−.21**	.11	-		
19. BJ (m)	−.05	.10	−.22**	−.20**	−.04	−.06	.10	.28**	.24**	.21**	.10	−.10	−.28**	.13	−.12	−.26**	.08	.59**	-	
20. EJ (m)	−.04	.05	−.16**	.14	−.11	.03	.17**	.15**	.14*	.23**	−.09	.03	−.13	.07	−.15**	−.15**	.10	.34**	.29**	-

Note. Ex = Extraversion; Em = Emotionality; Ag = Agreeableness; Co = Conscientiousness; Op = Openness; Ho = Honesty-Humility, Di = Disintegration; CJ = Cognitive jealousy; BJ = Behavioral jealousy; EJ = Emotional jealousy; w = women; m = men.

* $p < .05$. ** $p < .01$.

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Research Article

Investigating the Links between Physical Activity, Emotion Regulation, and Mental Health: Comparison in Active, Recreational, and Non-athletes

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ABSTRACT

This research aimed to investigate the relationship between physical activity and mental health, focusing on the potential mediating role of emotional regulation. We investigated whether physical activity predicts the degree of distress and whether this potentially significant relationship can be mediated by two strategies of emotion regulation - cognitive reappraisal and emotional suppression. Then, we tested the mentioned mediation model within three subsamples – active athletes, recreational athletes, and non-athletes. A mediation analysis conducted on the entire sample revealed the existence of partial mediation. In addition to the significant total effect, physical activity had a significant direct effect on distress and a significant indirect effect through both tested emotion regulation strategies. More physical activity predicts more use of cognitive reappraisal, which then predicts lower distress. Also, more physical activity predicts more use of emotional suppression, which predicts higher distress. Such results suggest that engaging in physical activity can lead to a decrease and an increase in distress, depending on which emotion regulation strategy a person relies on. Mediation analyses conducted on subsamples provided arguable confirmation of the mediation model only in the case of recreational athletes. The results obtained within the subsamples are discussed in detail.

Keywords: physical activity, mental health, emotion regulation, distress

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Introduction

Psychologists are particularly interested in how people can actively influence their emotional reactions, believing that people are active in expressing their emotions and not just passive recipients. Emotion regulation can be described as an individual's conscious or automatic effort to influence their subjective experience of emotions and the ways of expressing those (Gross et al., 2006). This process involves changes in various aspects of emotion, such as situation, attention, evaluation, subjective experience, behavior, and physiological processes. The goal of emotion regulation is usually to decrease or increase the emotional response – both in intensity and duration (Gross & Thompson, 2007). Researchers mainly focus on regulating negative emotions because reducing the intensity and duration of negative emotions is particularly important for an individual's well-being. Some research findings indicate that differences in how people regulate their emotions can significantly affect various aspects of their lives, including health (Mauss et al., 2007). At the end of the 20th century, James Gross formulated the most comprehensive theoretical framework of emotion regulation through his Process Model of the Origin of Emotions (Gross, 1998), which became widely accepted in different areas of psychology (Gross et al., 2006). According to this model, the beginning of an emotional process is a situation or a mental representation a person evaluates. This evaluation triggers adaptive responses to that situation, including experiential, behavioral, and physiological aspects. All of these responses can be modulated, which shapes the final expression of emotion. Lazarus provides empirical support for these considerations with a series of studies that show a measurable benefit from specific ways of emotion regulation (Lazarus & Folkman, 1984, according to Gross, 1998). Those studies conclude that emotion regulation causes changes in the dynamics of emotions because it affects the appearance, intensification, maintenance, and mitigation of experiential and behavioral reactions, and physiological processes that underlie them (Ochsner & Gross, 2005).

Forms of emotion regulation are generally divided into antecedent-focused and response-focused strategies. Antecedent-focused strategies refer to the regulation of an activating situation, precisely to our actions,

before an emotional response is fully developed, changing our behavior and peripheral physiological response. On the other hand, response-focused strategies allude to the regulation of emotional reactions that occur later in regulating the activating situation. It refers to an emotional response that has already occurred to reduce a solid physiological and inappropriate behavioral response (Gross & John, 2003). Gross and John (2003) chose one from both general groups of emotion regulation strategies and proposed a distinction between cognitive and behavioral emotion regulation. Cognitive emotion regulation is the reinterpretation of an emotionally arousing situation in a way that changes the emotional response, and this strategy is called cognitive reappraisal. Behavioral emotion regulation suppresses the outwardly visible expression of an emotional response. Hence, the name of this strategy is emotional suppression. Therefore, emotional suppression refers to an emotional response that has already occurred, and cognitive reappraisal occurs before the emotional response occurs, thereby affecting its intensity and quality (Ochsner & Gross, 2005). Previous findings suggest that emotional suppression of positive emotions reduces their subjective experience, but this is not true regarding negative emotions (e.g., Gross, 1999). Additionally, people who use cognitive reappraisal experience more positive and less negative emotions, while those who use emotional suppression experience and express less positive emotions but experience more negative emotions (e.g., Gross & John, 2003).

In previous research, physical activity has been examined as a supplementary activity within the framework of emotion regulation (e.g., Zhang et al., 2019). In general, the significance of the relationship between physical exercise and mental health has grown considerably in contemporary scientific inquiry (e.g., Rebar et al., 2015). Researchers are exploring a spectrum of interests, ranging from its preventive role of physical activity in mental well-being (e.g., Chekroud et al., 2018) to its potential as a therapeutic intervention for mental health disorders (e.g., Zschucke et al., 2013). According to Caspersen et al. (1985), physical activity encompasses any movement initiated by skeletal muscles that necessitates energy consumption. It includes movement in various contexts, such as leisure activities, transportation, or occupational tasks. Both moderate and vigorous physical activities have health-enhancing effects. Although they are synonyms in everyday life, separating the term physical exercise from the

term physical activity is necessary. Physical exercise refers to a segment of physical activity distinguished by its deliberate, organized, and repetitive nature, aiming directly or indirectly at enhancing or preserving physical fitness (Caspersen et al., 1985). This research focuses on the broader term – physical activity and its relationship with emotion regulation and mental health of people from the general population. More specifically, we are interested in whether physical activity significantly predicts the respondents' distress and whether emotion regulation mediates this relationship. Previous research has revealed that emotion regulation is closely related to physical activity (e.g., Neta et al., 2019) and various problems from the domain of psychopathology (e.g., Garnefski et al., 2002). Despite the close association between physical activity and different mental health indicators, it is rare to find studies investigating emotion regulation as a potential mechanism mediating the relationship between these two constructs (e.g., Fuentealba-Urra et al., 2023). Therefore, this study aimed to determine whether emotion regulation is the mechanism by which physical activity is related to the distress of the respondents. Due to the consistent findings of previous studies, showing that different intensity of physical activity has differental connections with mental health indicators (e.g., Wicker & Frick, 2015), we will examine the mentioned relationship separately in active athletes, recreational athletes, and non-athletes.

Method

Participants and Procedure

The sample consisted of 1061 respondents from the general population, comprising 713 females (67.20%) and 348 males (32.80%), aged between 18 and 75 years (M = 26.05, SD = 10.00). In addition, this sample included 184 active athletes (17.34%), 557 recreational athletes (52.50%), and 320 non-athletes (30.16%). The respondents' age is shifted towards younger adulthood, most likely due to how the sample was collected. Respondents filled out an online questionnaire in Google Forms as part of a larger project related to connecting physical activity with mental health between March 2022 and October 2023. The sample is suitable because students collected it as part of their coursework, for which they received

additional course credits. The inclusion criterion for research participation was that the potential respondent was an adult (at least 18 years old); respondents who did not meet this criterion were excluded from the final sample. All respondents consented to voluntary participation by selecting a respective option in the online questionnaire.

Instruments and variables

The Godin Leisure-Time Exercise Questionnaire (GLTEQ)

The Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin, 2011; adapted into Serbian by Popov et al., 2021) is a self-administered assessment tool for weekly physical activity levels. In this context, physical activity refers to activities performed for at least 15 minutes during the week prior to completing the questionnaire. Responses provided by participants allow for the classification of physical activity into three distinct categories: light (e.g., yoga, leisurely walking), moderate (e.g., casual cycling, tennis), and strenuous (e.g., running, roller skating). The total leisure activity score is computed by multiplying the weekly frequencies of activity in each category by their respective metabolic equivalents ([Strenuous x 9] + [Moderate x 5] + [Light x 3]; Godin, 2011).

Self-assessment of Physical Activity

In addition to administering the GLTEQ, participants were questioned regarding their self-perceived physical activity status, delineating between categories such as non-athletes, recreational athletes, or active athletes.

The Depression, Anxiety, Stress Scale (DASS-21)

The Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a 21-item instrument comprising three distinct subscales. The Depression subscale gauges manifestations of dysphoria, helplessness, anhedonia, inertia, and diminished self-esteem (α=.90, seven items, e.g., "I felt that I had nothing to look forward to."). The Anxiety subscale quantifies physiological arousal, somatic reactions, and subjective experiences of situational anxiety (α=.90, seven items, e.g., "I felt scared without any good reason."). Lastly, the Stress subscale evaluates chronic, non-specific arousal, incapacity to relax, nervousness, impatience, proneness to

agitation, irritability, and tendencies to over-react (α=.88, seven items, e.g., "I tended to over-react to situations."). The purpose of the DASS-21 is to provide a comprehensive assessment of an individual's emotional state. Responses are elicited using a four-point Likert-type scale ranging from (0) "*not at all*" to (3) "*mostly, almost always*."

Emotion Regulation Questionnaire (ERQ) - The Serbian Adaptation

The Serbian adaptation of the ERQ emotion regulation questionnaire (Popov et al., 2016) contains ten items and measures two distinct emotion regulation strategies. The first strategy is Cognitive Reappraisal (CR), which occurs before the emotional response is completely formed. It involves reinterpretation of an emotionally evoking situation, aiming to change its emotional impact. For example, "When I find myself in a stressful situation, I try to think about it in a way that helps me stay calm." This item reflects the use of cognitive reappraisal to reduce stress. The second strategy is Emotional Suppression (ES), which regulates an already-formed emotional response. It involves inhibiting the outward expression of emotions. For example, "I control my feelings by not showing them." This item reflects the use of emotional suppression to manage emotional reactions. A seven-point Likert-type scale for answering, from (1) "*do not agree at all*" to (7) "*completely agree*," was used as a response format.

Results

Descriptive parameters are shown in Table 1. According to the values of skewness and kurtosis, all variables were normally distributed (skewness < ±2, kurtosis < ±7; Hair et al., 2010).

Table 1

Descriptive parameters of the variables

	Theoretical range	Empirical range	*M*	*SD*	*Sk*	*Ku*
Physical Activity (GLTEQ)	0-119	0-119	34.12	26.72	1.09	.97
Distress (DASS-21)	0-63	0-63	20.84	15.61	.65	-.49

Cognitive Reappraisal (CR)	6-42	6-42	27.66	7.40	-.20	-.33
Emotional Suppression (ER)	4-28	4-28	15.00	5.64	.14	-.56

Intercorrelations among variables are shown in Table 2. The leisure physical activity correlated statistically significantly with all other examined variables. More specifically, leisure physical activity exhibited a low negative correlation with distress and a low positive correlation with cognitive reappraisal. There is also a positive but higher correlation with emotional suppression. Such results suggest that more leisure physical activity was associated with lower distress and more frequent use of both tested emotion regulation strategies, especially emotional suppression. Aside from the correlation with leisure-time physical activity, emotional suppression achieved statistically significant, moderate, and positive correlations with cognitive reappraisal and distress. Therefore, among the respondents who recorded more use of emotional suppression, greater use of cognitive reappraisal was also detected, and so was a higher degree of distress.

Table 2

Intercorrelations among the variables

		1	2	3	4
1	Physical Activity (GLTEQ)	-			
2	Distress (DASS-21)	-.069*	-		
3	Cognitive Reappraisal (CR)	.067*	.002	-	
4	Emotional Suppression (ER)	.105**	.232**	.256**	-

Note. * $p < .05$. ** $p < .01$.

In order to test the differences in all examined variables between groups with various levels of physical activity (non-athletes, recreational athletes, and active athletes), we conducted a one-way analysis of variance. The results revealed small to large statistically significant between-group effects in the case of all examined variables (physical activity, distress,

cognitive reappraisal, and emotional suppression; Table 3). Games-Howell post-hoc test for multiple comparisons (Games & Howell, 1976) found that physically inactive respondents reported significantly higher scores on distress compared to recreational athletes (*Mdif* = 5.16, 95% CI [2.52, 7.80], *p* = .003), as well as compared to active athletes (*Mdif* = 6.98, 95% CI [3.59, 10.37], *p* < .001). At the same time, recreational athletes and active athletes did not significantly differ in their scores on the distress scale (*Mdif* = 1.82, 95% CI [-1.16, 4.80], *p* = .319). Regarding cognitive reappraisal, there was a statistically significant difference only between inactive respondents and recreational athletes (*Mdif* = -1.57, 95% CI [-2.81, -.33], *p* = .007). On the other hand, there were no statistically significant differences between inactive respondents and active athletes (*Mdif* = -.95, 95% CI [-2.62, .71], *p* = .372), and between recreational athletes and active athletes (*Mdif* = .62, 95% CI [-.88, 2.11], *p* = .601). Examining the differences in emotional suppression, a statistically significant difference was obtained only between recreational athletes and active athletes (*Mdif* = -1.22, 95% CI [-2.34, -.10], *p* = .034). Conversely, no statistically significant differences were found between inactive respondents and recreational athletes (*Mdif* = .25, 95% CI [-.71, 1.20], *p* = .822) nor between inactive respondents and active athletes (*Mdif* = -.98, 95% CI [-2.24, .28], *p* = .158).

Table 3

Differences among the variables due to the level of physical activity

Groups 0: non-athletes (n = 320) 1: recreational athletes (n = 557) 2: active athletes (n = 184)		*F* (*df* = 2, 1058)	ω^2	Games-Howell post-hoc test
	M (SD)			
Physical Activity (GLTEQ)	0: 15.33 (15.23) 1: 35.37 (21.18) 2: 63.00 (30.11)	289.121**	.35	2 > 0, 1 1 > 0
Distress (DASS-21)	0: 24.77 (16.66) 1: 19.60 (14.79) 2: 17.78 (14.91)	15.823**	.03	0 > 1, 2
Cognitive Reappraisal (CR)	0: 26.67 (7.77) 1: 28.24 (7.07) 2: 27.63 (7.56)	4.599*	.01	0 < 1

Emotional Suppression (ER)	0: 14.96 (6.02) 1: 14.72 (5.38) 2: 15.94 (5.65)	3.281*	.01	2 > 1

Note. ω^2 of value .01 indicates a small effect, .06 indicates a medium effect, and .14 indicates a large effect (Field, 2013).
* $p < .05$. ** $p < .01$.

In the following step, parallel multiple mediation analysis was applied. Mediation analysis is a statistical method used to test hypotheses about how some causal predictor variable X transmits its effect on a criterion variable Y. In a parallel multiple mediation model, predictor variable X is modeled as influencing criterion variable Y directly and indirectly through two or more mediators (Hayes, 2022). In this research, the predictor variable was physical activity, the criterion variable was distress, and two emotion regulation strategies - cognitive reappraisal and emotional suppression were included as potential mediators.

Table 4

Parameters of tested regression models for the total sample

Model	Path	*R*	R^2	ΔR^2	*F (df1, df2)*	*p*
1	X on Y	.07	.01	.01	5.311 (1, 1059)	.022
2	X on M1	.07	.01	.01	4.768 (1, 1059)	.032
	X on M2	.10	.01	.01	11.790 (1, 1059)	.000
	X, M1 and M2 on Y	.26	.07	.06	24.759 (3, 1057)	.000

Note. X – physical activity as a predictor variable. Y – distress as a criterion variable. M1 – cognitive reappraisal as mediator 1. M2 – emotional suppression as mediator 2.

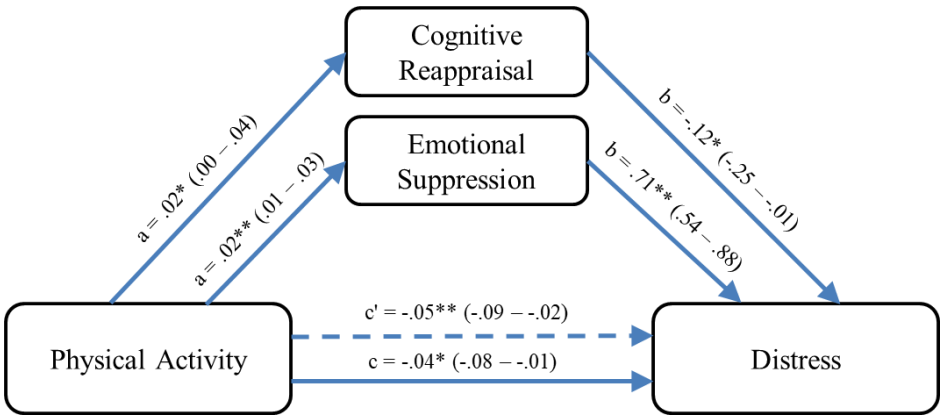
Table 4 shows the results of the simultaneous examination of the mediating role of two emotion regulation strategies in the relationship between physical activity and distress in the entire sample. As shown in the model in Figure 1, the total effect of physical activity on distress was small but statistically significant. When fractioning the total effect, the direct effect was also statistically significant. The same occurs when it comes to the indirect effect. Taking into consideration the previously written, this model

suggests the existence of partial mediation, where some of the effects of physical activity on distress follow a direct pathway. Other portions followed an indirect pathway via both tested strategies of emotion regulation. The explication of the shown model also suggests a conclusion about the opposite regression effect of emotional suppression on both the total and indirect effects. Namely, more physical activity within the total effect predicts lower distress.

Additionally, more physical activity predicts more cognitive reappraisal, which predicts lower distress. On the other hand, more physical activity predicts more emotional suppression and more emotional suppression predicts higher distress, which is statistically the most significant result. It is assumed that they reduce the significance of physical activity's total and indirect effect on the degree of distress.

Figure 1

Mediation model of emotion regulation between physical activity and distress in the total sample



Note. all values are unstandardized regression coefficient values with 95% confidence intervals, bootstrapped on 5000 randomly generated data sets. a – effect of X on M. b – effect of M on Y. ab – indirect effect X through M. c' - direct effect of X on Y. c – total effect of X on Y. * $p < .05$. ** $p < .01$.

After observing the entire sample, the presented interrelationships between the variables were tested within each subsample, with the subsamples being formed based on the respondents' engagement in physical activity. For the subsample of active athletes, the results of simultaneously examining the mediating role of two emotion regulation strategies in the relationship between physical activity and distress are shown in Table 5.

Table 5

Parameters of tested regression models for active athletes

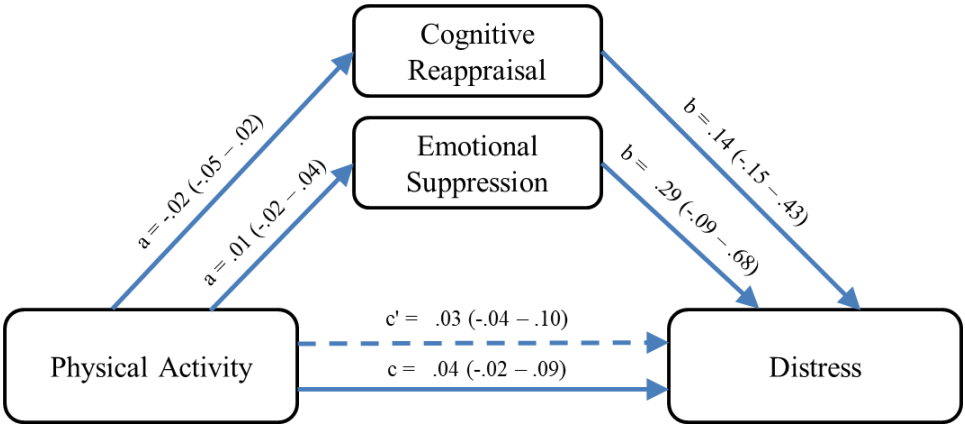
Model	Path	*R*	R^2	ΔR^2	*F (df1, df2)*	*p*
1	X on Y	.05	.01	.01	.609 (1, 182)	.222
2	X on M1	.07	.01	.01	.861 (1, 182)	.351
	X on M2	.05	.00	.00	.503 (1, 182)	.482
	X, M1 and M2 on Y	.15	.02	.01	1.411 (3, 180)	.243

Note. X – physical activity as a predictor variable. Y – distress as a criterion variable. M1 – cognitive reappraisal as mediator 1. M2 – emotional suppression as mediator 2.

As shown in the model in Figure 2, all tested relations are statistically insignificant. In the case of active athletes, more physical activity did not predict lower distress, nor did the use of either tested emotion regulation strategy. Also, the use of the tested strategies did not predict the degree of distress experienced by active athletes. These results strikingly deviate from those obtained on the total sample and justify the examination of the mentioned relations on the remaining subsamples.

Figure 2

Mediation model of emotion regulation between physical activity and distress in the subsample of active athletes



Note. All values are unstandardized regression coefficient values with 95% confidence intervals, bootstrapped on 5000 randomly generated data sets. a – effect of X on M. b – effect of M on Y. ab – indirect effect X through M. c' - direct effect of X on Y. c – total effect of X on Y. * $p < .05$. ** $p < .01$.

Examining whether emotion regulation strategies mediate the relationship between physical activity and distress in a subsample of recreationists indicated the existence of several statistically significant relationships but not the significance of the total effect (Table 6).

Table 6

Parameters of tested regression models for recreational athletes

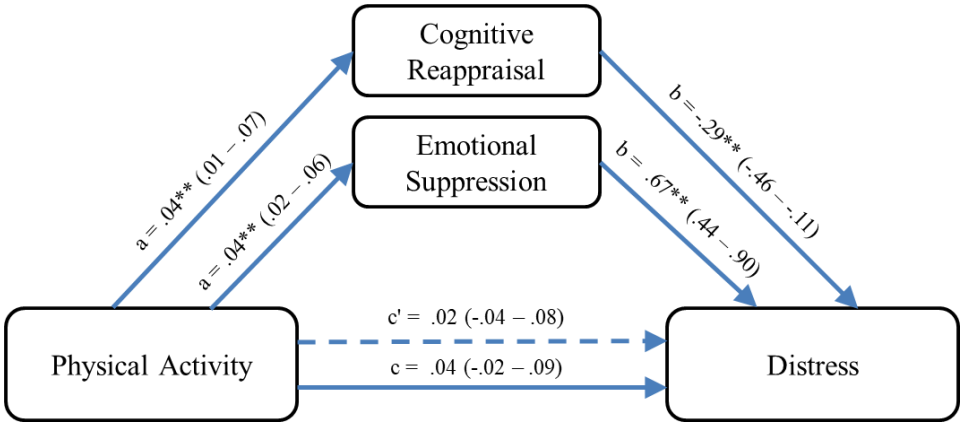
Model	Path	*R*	R^2	ΔR^2	*F (df1, df2)*	*p*
1	X on Y	.05	.01	.01	1.494 (1, 555)	.223
2	X on M1	.12	.01	.01	7.648 (1, 555)	.011
	X on M2	.17	.03	.03	15.991 (1, 555)	.000
	X, M1 and M2 on Y	.26	.07	.06	12.933 (3, 553)	.000

Notes. X – physical activity as a predictor variable. Y – distress as a criterion variable. M1 – cognitive reappraisal as mediator 1. M2 – emotional suppression as mediator 2.

More precisely, the results indicate that more physical activity significantly predicts more cognitive reappraisal, which predicts a lower degree of distress. Also, more physical activity predicts more significant use of emotional suppression, which predicts higher levels of distress. However, the model shown in Figure 3 indicates that physical activity does not predict distress in recreational athletes. In the next section, the absence of a significant total effect will be discussed, as well as whether the assumption of the existing mediation is still acceptable.

Figure 3

Mediation model of emotion regulation between physical activity and distress in the subsample of recreational athletes



Note. All values are unstandardized regression coefficient values with 95% confidence intervals, bootstrapped on 5000 randomly generated data sets. a – effect of X on M. b – effect of M on Y. ab – indirect effect X through M. c' - direct effect of X on Y. c – total effect of X on Y. * $p < .05$. ** $p < .01$.

Table 7 shows the results related to the subsample of the non-athletes, which were obtained when the mediating role of emotion regulation in the relationship between physical activity and distress was examined.

Table 7

Parameters of tested regression models for non-athletes

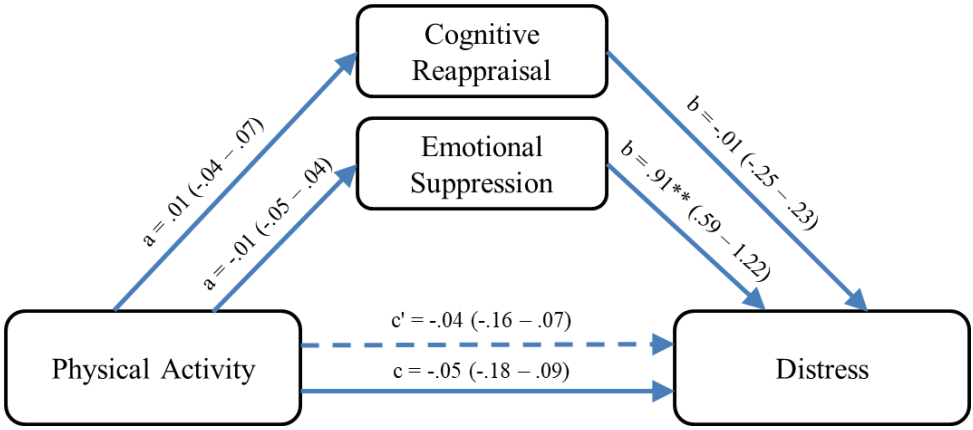
Model	Path	*R*	R^2	ΔR^2	*F (df1, df2)*	*p*
1	X on Y	.05	.01	.01	.680 (1, 318)	.411
2	X on M1	.03	.00	.00	.228 (1, 318)	.633
	X on M2	.02	.00	.00	.091 (1, 318)	.761
	X, M1 and M2 on Y	.33	.11	.10	12.772 (3, 316)	.000

Note. X – physical activity as a predictor variable. Y – distress as a criterion variable. M1 – cognitive reappraisal as mediator 1. M2 – emotional suppression as mediator 2.

As shown in the model in Figure 4, all tested relations were statistically insignificant except one. In the case of non-athletes, more physical activity did not predict lower distress, nor did the use of either tested emotion regulation strategy. The exception of the only significant result suggests that in our non-athlete subsample, more emotional suppression significantly predicts higher levels of distress. However, this is a subsample characterized by a rare or complete absence of physical activity, and the insignificant relationship of this variable with all other tested variables was not surprising.

Figure 4

Mediation model of emotion regulation between physical activity and distress in the subsample of non-athletes



Note. All values are unstandardized regression coefficient values with 95% confidence intervals, bootstrapped on 5000 randomly generated data sets. a – effect of X on M. b – effect of M on Y. ab – indirect effect X through M. c' - direct effect of X on Y. c – total effect of X on Y. * $p < .05$. ** $p < .01$.

Discussion

This research aimed to investigate the relationship between physical activity and mental health, focusing on the potential mediating role of emotional regulation. When focusing solely on the connection between physical activity and mental health, previous research has shown a significant but complex relationship (e.g., Stubbs et al., 2018). The absence of physical activity or very little physical activity can be used as a predictor of the development of mental disorders (e.g., Teychenne et al., 2020) and vice versa – people with diagnosed mental disorders consistently report reduced or no physical activity (e.g., Scheewe et al., 2019). Because of findings like these, physical activity is assumed and proposed in practice as a tool for preventing mental health issues and improving existing mental health challenges (e.g., Mizrahi et al., 2023). In our previous study (Popov et al., 2023), physically inactive individuals scored lower on all measures of

positive mental health indicators and higher on all measures of negative mental health indicators compared with recreational athletes and active athletes. At the same time, there were no significant differences in these measures between recreationists and active athletes. This finding is consistent with the results of numerous studies conducted abroad, according to which frequent moderate to vigorous physical activity is beneficial for people's mental health in general (e.g., Wiese et al., 2017), as well as for reducing psychological distress (e.g., Gucciardi et al., 2019) – an indicator of mental health that we used in this paper. However, as a particular limitation of previous studies, some authors emphasize not dealing with a fundamental conceptual understanding of the relationship between physical exercise and mental health. More specifically, research attention is usually not focused on explaining the underlying processes by which physical activity affects people's mental health (Martin & Wade, 2000). There are several mechanisms by which some authors explain how an increase in physical activity reduces the degree of distress. It is theorized that moderate to strenuous physical activity facilitates the activation of adaptive psychological and social mechanisms – for example, the growth of self-esteem or the reduction of loneliness – which may protect against psychological distress (e.g., Cairney, 2009).

Emotion regulation has been previously suggested as a potential mediator in the relationship between physical activity and overall well-being (e.g., Booker et al., 2014) or with different mental health indicators (e.g., Yang et al., 2024). However, we had difficulties finding a study where distress was selected as such an indicator. We started from the assumption that emotion regulation can mediate the relationship between physical activity and distress, given that emotion regulation strategies and physical activity are related constructs (e.g., Neta et al., 2019). One of the two strategies of emotion regulation included in this paper is cognitive reappraisal, which refers to a reinterpretation of an emotionally arousing situation in a way that changes the emotional response to the situation (e.g., Gross & John, 2003). This emotion regulation strategy is considered to be related to physical activity, given that physical activity can also be used as a form of reassessment. When experiencing distress, physical activation can help redirect attention, allowing a person to reassess the situation more positively – and this change in focus can further help reduce distress (Perchtold-Stefan

et al., 2020). Emotional suppression, another tested strategy, attempts to hide, inhibit, or reduce outwardly visible expression of an emotional response (e.g., Gross & John, 2003). This emotion regulation strategy is also related to physical activity because physical activity can express the emotions a person typically suppresses. Diminishing emotional suppression and physical activity enables individuals to express their emotions, which can reduce acute emotional distress (Edwards et al., 2018).

The obtained results indicate that physically inactive respondents had significantly higher symptoms of distress compared to recreational athletes and active athletes. In contrast, recreational and active athletes did not significantly differ in the scores on the distress scale. This finding completely corresponds to the findings of previously mentioned studies that inactive individuals are more emotionally agitated than those who are physically active. Regarding cognitive reappraisal, the only difference large enough to be declared statistically significant was between physically inactive and recreationally active individuals. More precisely, recreational athletes used cognitive reappraisal significantly more than physically inactive respondents. This corresponds to the previously mentioned finding that people who engage in physical activity are less distressed, whereby a lower degree of distress is also associated with people who perform emotion regulation through cognitive reappraisal. The lack of significance between inactive respondents and active athletes can be explained by the finding that active athletes engage in physical activity for different reasons from recreational athletes. Active athletes engage in physical activity professionally and according to a predetermined schedule rather than following their current psychological needs (which is the feature of recreational athletes). Because of this circumstance, the mechanisms by which physical activity affects mental health can be completely different, even though both groups are physically active. Examining the differences in emotional suppression, the only difference large enough to be declared statistically significant was between recreational and active athletes. Active athletes used significantly more emotional suppression than recreationists, which confirms what was written previously – it is justified to assume that the activation of different psychological mechanisms, such as different

emotion regulation strategies, can accompany different psychological approaches to physical activity.

Examination of the mediating role of emotion regulation strategies in the relationship between physical activity and distress in the entire sample indicates the existence of partial mediation. In addition to the significant total effect, physical activity had a significant direct effect on distress and a significant indirect effect through both tested emotion regulation strategies. Such results suggest that more physical activity predicts lower distress in a general population sample. Additionally, more physical activity predicts more use of cognitive reappraisal, which predicts lower distress. On the other hand, in contrast to our initial expectations, more physical activity predicts more use of emotional suppression. After that, it was to be expected that more use of emotional suppression predicts higher distress. This means that engaging in physical activity can decrease or increase distress, depending on the emotion regulation strategy a person uses. Cognitive reappraisal unambiguously leads to a lower degree of distress. As already stated, if physical activity is defined as an opportunity to ventilate emotional states that a person usually suppresses, physical activity should also lead to a reduction of distress through the reduction of emotional suppression. However, the findings obtained in this study lead to the conclusion that physical activity also distracts from emotional states; for example, it allows the individual to continue suppressing emotions, which is consequently associated with higher distress. This conclusion aligns with studies showing that the suppression of emotions negatively impacts people's mental health, including emotional distress (e.g., Cutuli, 2014).

When observing separate subsamples, the following can be concluded: In the case of active athletes, more physical activity did not predict lower distress, nor did the use of both tested emotion regulation strategies. Furthermore, using the tested strategies also did not predict the degree of distress. The absence of a significant relationship between physical activity and distress may be initially surprising. However, it can be explained by the fact that the practice of physical activity in active athletes drastically differs from that in those who do not engage in it professionally. Unlike recreational athletes, for active athletes, engaging in physical activity brings both pleasure and stress, which arises from competitive experiences or the

complex social and organizational environment in which athletes work (Fletcher & Arnold, 2017). Therefore, it can be assumed that physical activity can have a dual effect on distress; these two effects suppress each other, which is why an insignificant association was obtained. The subsample of non-active individuals shows that almost all tested relationships were insignificant. However, this result is not surprising given that we are talking about individuals who minimally or do not engage in physical activity. Therefore, it is reasonable to conclude that, in their case, the construct of physical activity is insignificantly related to all other variables tested in the mediation model. Lastly, in the case of recreational athletes, more physical activity did not predict lower distress but predicted the use of both tested emotion regulation strategies, and the use of both strategies of emotion regulation predicted the degree of distress. More precisely, more physical activity significantly predicts more cognitive reappraisal, which predicts a lower degree of distress, and more emotional suppression, which predicts higher levels of distress.

Nevertheless, the results indicate that physical activity does not predict distress in recreational athletes, which begs whether the absence of a significant total effect still allows testing the assumption of the existing mediation. Historically, it has been considered justified to conduct a mediation analysis only if three essential criteria are met; the first is that predictor variable and criterion variable are significantly related (Baron & Kenny, 1986). However, in recent years, there has been a growing awareness that such thinking is wrong and outdated and that the lack of correlation does not disprove causation. Mediation analysis no longer imposes evidence of a simple association between predictor variable X and criterion variable Y as a precondition, i.e., the correlation between X and Y is not necessary for testing a mediation between them (Hayes, 2022). Guided by that, we will interpret the obtained results as a confirmation of the mediating role of emotion regulation strategies in the relationship between physical activity and distress in recreational athletes. This means that in a sample of recreational athletes, more physical activity predicts more use of cognitive reappraisal, and more use of this strategy predicts lower distress. Also, more physical activity predicts more use of emotional suppression, and more use of this strategy predicts higher distress. Engaging in physical activity can have

positive and negative effects on the distress of recreationists, depending on which emotion regulation strategy they use. Direct practical implications arise from the mentioned finding, given that it has been identified what should be encouraged and what should be changed in people who engage in recreational physical activity in order for this activity to have a positive impact on people's mental health.

Concerning the practical implications of the results according to subsamples, we can conclude the following: In professional athletes, physical activity alone does not directly lead to distress reduction, nor do the examined emotion regulation strategies. These results indicate that physical activity in a competitive environment has a more complex psychological impact, including positive emotions and stress. Therefore, interventions aimed at reducing distress in active athletes should focus on managing specific stressors (e.g., organizational or competitive) and not only increasing physical activity or changing emotion regulation strategies. On the other hand, supporting more frequent physical activity in recreational athletes might be beneficial to their mental health, but its effectiveness depends on applied emotion regulation strategies. Encouraging cognitive reappraisal (which lowers distress) and discouraging emotional suppression (which increases distress) can help recreational athletes better manage their emotions and improve mental health outcomes. Finally, considering that the level of distress in inactive individuals is the highest, but in the mediation analysis, physical activity is unrelated to the degree of distress or emotional regulation, the proposed interventions would have to be more complex. Encouraging physical exercise alone may not bring immediate mental health benefits, so simultaneously addressing other factors that affect emotional well-being is recommendable.

This study's cross-sectional design limits its ability to establish causality between physical activity, emotion regulation, and distress. The proposed predictive relationships are based on theory and prior findings. In addition, gender and age differences in physical activity, degree of distress, or use of emotion regulation strategies were not taken into account. Overcoming these limitations is recognized as a guideline for future research work. Finally, self-report questionnaires are prone to recall biases (Schuch et al., 2018). Future studies should use objective measures for physical activity

and ensure accurate classification of participants into active, recreational, or inactive categories.

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Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data files are available upon a reasonable request.

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Research Article

The Serbian Short Version of the Mental Health Literacy Questionnaire for Young People (MHLq-yp): Validation with a Sample of Elementary School Students

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ABSTRACT

The last few decades have brought an elaboration of the concept and the development of valid and reliable measures of mental health literacy (MHL) in adults, children, and adolescents. Nevertheless, most of the empirical evidence on MHL has come from developed, high-income Western countries. The present study aimed to develop a short Serbian version of the Mental Health Literacy Questionnaire for Young People (MHLq-yp), suitable for application in elementary school settings. The original version of the MHLq-yp has been adapted into Serbian following the back-translation methodology and think-aloud procedure. This questionnaire was validated in a sample of 386 primary school students (52.2% girls) aged 11 to 14 years (M_{age} = 12.63, SD_{age} = 0.88). Based on exploratory factor analysis and internal consistency indices, a short version of the instrument was developed, showing good internal and convergent validity.

Keywords: literacy, mental health, elementary school, validity, Serbia

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Introduction

Mental health problems typically emerge during childhood and adolescence (Belfer, 2008; Freţian et al., 2021), with 75% of mental disorders starting before the age of 25 and 50% developing by the age of 14 (Kessler et al., 2005). However, research shows that only 18-34% of young people with pronounced symptoms of depression and anxiety seek professional help (Gulliver et al., 2010), indicating a significant portion of young people remain without necessary intervention and support. The probability of early mental health problem recognition and the appropriate help-seeking behaviors is higher with the appropriate "literacy" in this field (Kitchener & Jorm, 2004). Thus, mental health literacy (MHL) is considered a significant determinant of mental health (Bjørnsen et al., 2017).

MHL has received increased attention in recent years. The term originally referred to knowledge and beliefs about mental disorders that aid in their detection, treatment, or prevention (Jorm et al., 1997). Jorm (2012) later proposed a broader conceptualization that includes knowledge of how to prevent mental disorders, recognizing the onset of a disorder, understanding help-seeking options and treatments, and knowing effective self-help strategies for milder problems, as well as first aid skills to support others with mental health issues. Kutcher and colleagues (2013) expanded upon this by proposing a four-component MHL model that addresses stigma and help-seeking efficacy (Kutcher et al., 2016), while Bjørnsen et al. (2017) referred to the component of maintaining positive mental health as ''positive mental health literacy".

Specific mental disorders recognition, knowledge about mental disorders, treatments, and help-seeking among the younger population is generally poor and varies from study to study (Renwick et al., 2022). Levels of MHL can differ by gender (Aluh et al., 2018; Campos et al., 2016; Coles et al., 2016; Cotton et al., 2006; Essau et al., 2013), age (Campos et al., 2016; Essau et al., 2013; Jorm, 2007), and level of proximity to persons with mental health problems (Campos et al., 2016; Dias et al., 2018; Jorm, 2000; Lauber et al., 2001).

MHL is related to various mental health problems, such as depression, anxiety, and stress. Some studies showed a negative correlation

between MHL and symptoms of depression and anxiety (Calear et al., 2021; Lam, 2014; Liu et al., 2023; O'Brien, 2020; Singh et al., 2020; Yao et al., 2023), while others suggest the ability to recognize mental disorders is positively correlated with levels of depression (Al-Shannaq et al., 2023; Ozturan & Kocakaya, 2023). In one study among adolescents, more positive attitudes toward seeking help were associated with higher levels of general anxiety disorder literacy and lower self-stigma (Calear et al., 2021). Lower self-stigma levels were connected to seeking help from parents, while higher self-stigma was related to not seeking help from anyone (Calear et al., 2021). MHL is positively correlated with various aspects of mental health and well-being. It is positively correlated with mental health levels, happiness, and overall adaptation while being negatively correlated with psychological distress (Zhang et al., 2023). Also, MHL may have a protective effect on risky behaviors and may aid emotion regulation strategies in adolescents (Lubman et al., 2020). While MHL is found to be an important predictor of mental health problems, general well-being also highly predicts depression, anxiety, and stress outcomes (O'Brien, 2020). Furthermore, life satisfaction, as a cognitive component of subjective well-being, plays an important role in positive youth development (Park, 2004).

Assessing Mental Health Literacy

Jorm and colleagues (1997) began evaluating mental health literacy (MHL) in Australia through structured interviews and vignettes depicting individuals with mental health disorders. This method has been used in various countries and populations, including young people (Attygalle et al., 2017; Essau et al., 2013; Lam, 2014; Olsson & Kennedy, 2010; Sharma et al., 2017). However, research on MHL in Serbia, particularly among children and youth, is scarce. To our knowledge, there has been only one study with young people in Serbia using this methodology (Popić et al., 2014); it involved 1,000 third-grade students from 40 randomly selected secondary schools and found low levels of MHL. Despite its wide use, this methodology has limitations, such as lengthiness, a narrow focus on specific mental disorders, and difficulties with repeated measurements. New instruments have been developed to address these issues, but most of them still primarily measure

the mental illness component of MHL rather than the mental health component (Liu et al., 2023).

One of the instruments that overcomes the aforementioned constraints is the *Mental Health Literacy Questionnaire for young people (MHLq-yp)*. It is constructed to assess MHL among young people and evaluate the effectiveness of programs promoting MHL among youth (Campos et al., 2016). It consists of 33 items grouped into three factors: First aid skills and Help-seeking (FA/HS) (10 items, e.g., "If I had a mental disorder, I would seek professional help (psychologist and/or psychiatric"), Knowledge/Stereotypes (Kn/St) (18 items, e.g., "Mental disorders affect people's thoughts") and Self-help strategies (SHS) (5 items, e.g., "Good sleep helps to improve mental health"). Participants answer using a Likert-type rating scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In addition to the scores for the specified dimensions, the total score for the 33 items can also be calculated. A higher score implies a higher level of MHL. Previous studies (Campos et al., 2016) have shown good reliability and internal consistency for these factors: First aid skills and Help-seeking $\alpha = .79$; Knowledge/Stereotype $\alpha = .78$; Self-help strategies $\alpha = .72$; Total score $\alpha = .84$. In 2018, Dias et al. (2018) adapted this questionnaire for young adults, and later, a short version of the questionnaire was developed for adults (Campos et al., 2022). However, there has not been a similar adaptation for children and adolescents. A short form of the MHL measure would be useful for several reasons. First, it would take less time to fill it out, which is especially important when working with elementary school students. Furthermore, researchers could include additional scales of interest within the same questionnaire. Assessing MHL is an important first step toward gaining insight into the baseline level of MHL and designing interventions to improve MHL (Renwick et al., 2022).

Therefore, our study aimed at (1) translating and adapting the MHLq version for young people for the Serbian language, (2) exploring the factor structure and internal consistency of the Serbian version and devising a shorter version of the scale, and (3) evaluating the shorter version's internal consistency and external validity.

Method

Sample

Convenience sampling was used. Data were collected in four elementary schools, all located in Belgrade. The initial sample consisted of 424 students. Participants with ten or more missing values (considering the entire questionnaire) were excluded from further analyses. The final sample included a total of 386 students (52.2% girls) attending the sixth (33.4%), seventh (43.9%), or eighth grade (22.6%), ranging in age from 11 to 14 years (M = 12.63, SD = 0.88). Serbian language was the mother tongue for all participants, and 98.7% reported that they were of Serbian nationality. Almost all participants (99.5%) stated that their parents were employed.

Procedure

In translating and adapting the MHLq-yp, we rigorously adhered to the recommended procedure from the instrument's authors: 1) English translation by a bilingual translator; 2) Think-aloud process with four participants; 3) Back-translation by another bilingual translator; 4) Semantic comparison with four participants; 5) Analysis by the Portuguese research team who developed the original questionnaire.

Before the study, informed consent was obtained from elementary school principals, parents, and students. Participants then anonymously and voluntarily completed the paper questionnaire during one school class (45 minutes). The questionnaires were distributed by researchers or school staff. After the assessment, participants received a debriefing text on youth mental health written by the researchers, covering the importance of monitoring mental health, identifying signs of psychopathology, and referral information. Additional references for further reading about mental health in children and adolescents were also provided.

Measures

The introductory section of the questionnaire included self-reports of gender and age. Participants rated their physical and mental health (using a

rating scale from 1 – very bad to 5 – very good). Participants were asked about their familiarity with individuals experiencing mental health issues, specifying the relationship closeness if applicable (family member/relative, friend, someone else, or themselves). Additionally, participants indicated how often they seek mental health information (1 - not at all, 5 - very often) and rated their level of mental health knowledge (1 - not at all informed, 5 - very informed). In a separate section, participants identified mental health disorders from a list including generalized anxiety, cerebral palsy, Down syndrome (Trisomy 21), Parkinson's disease, depression, stroke, and schizophrenia, with the option to select multiple disorders.

Depression, Anxiety, and Stress Scale - DASS-21

The DASS-21 (Lovibond & Lovibond, 1995; Serbian version: Jovanović et al., 2014) is a 21-item instrument used to assess symptoms of depression, anxiety, and stress in both clinical and nonclinical settings. The DASS-21 includes three subscales: Depression (7 items, "I felt that life was meaningless"), Anxiety (7 items, "I experienced trembling (e.g., in the hands)"), and Stress (7 items, "I found it hard to wind down"). Participants rate the presence of symptoms over the past two weeks using a 4-point response scale ranging from 0 (*did not apply to me at all/never*) to 3 (*applied to me very much or most of the time/always*). Scores for depression, anxiety, and stress are calculated by averaging scores of all items within subscales. The results of a previous study (Jovanović et al., 2014) have shown that the Serbian version of DASS-21 demonstrates good psychometric characteristics. Descriptives and internal consistency coefficients for all subscales are presented in Table 1.

Emotion Regulation Questionnaire - ERQ

The ERQ (Gross & John, 2003, Serbian version validated by Popov et al., 2016) was adapted for children based on suggestions of authors who created the version for children (ERQ - CA; Gullone & Taffe, 2012). It consists of 10 items capturing personal tendencies to reappraise and suppress the expression of emotions. Participants were asked to indicate their level of agreement with each item using the seven-point Likert scale (1 - *strongly disagree* to 7 - *strongly agree*). The ERQ is designed to assess two emotion regulation strategies: Cognitive reappraisal, with 6 items (e.g., "When I'm

faced with a stressful situation, I make myself think about it in a way that helps me stay calm"), and Expressive suppression, with 4 items (e.g., "I keep my emotions to myself"). A higher score implies a higher use of the strategy. Previous research indicated good internal consistency (α = .79 for reappraisal; α = .73 for suppression) and sound convergent and discriminative validity (Gross & John, 2003; John & Gross, 2004). The Serbian version of this questionnaire also showed satisfactory internal consistency (α = .64 for reappraisal; α = .71 for suppression), factor structure, and validity (Popov et at., 2016). Descriptives and internal consistency coefficients obtained in this study are presented in Table 1.

Self-Stigma of Mental Illness Scale – Short Form - SSMIS-SF

The SSMIS-SF (Corrigan et al., 2012) is designed to assess personal stigma toward people with mental health issues. It consists of five items describing people with mental health illness (e.g., "I think that most persons with mental health illness are unpredictable"). Participants answer using a nine-point Likert-type scale (1 - *strongly disagree* to 9 - *strongly agree*). In adapting this questionnaire for the Serbian population, three translators fluent in English (source language) and native in Serbian (target language) were included, all researchers within the fields of psychology or special education, and all having more than five years of experience in working with adolescents in educational or clinical settings. In the first step, two translators adapted the questionnaire independently. Then, a third translator did the back-translation. At the end of the process, a group discussion of translators with a specialist for adolescents took place, after which the final version of the scale was compiled. Higher scores indicate greater personal stigma. The SSMIS-SF has demonstrated good convergent and discriminant validity in prior research (Corrigan et al., 2012). Descriptives and internal consistency are presented in Table 1.

Brief Multidimensional Students' Life Satisfaction Scale - BMSLSS

The BMSLSS (Huebner et al., 2006; Riemer et al., 2014; Seligson et al., 2003) consists of six items that measure the self-perceived satisfaction with life in multiple domains: family life, friends, school experiences, self, where one lives, and in general (e.g., "I would describe my satisfaction with

my family life as"). The participants were asked to rate their satisfaction with the mentioned dimensions during the last few weeks on a seven-point Likert-type scale (1 - *very dissatisfied* to 7 - *very satisfied*). The six items were summed to create the total life satisfaction score. A higher score implies a higher life satisfaction. Previous research (Costa et al., 2022) suggested that the scale has good reliability (ω = 0.87). Also, CFA showed that the one-factor structure has an excellent fit (CFI = 0.972, RMSEA = 0.052, 90% CI [0.046, 0.058], SRMR = 0.028). The adaptation process described in the previous paragraph related to the SSMIS-SF was repeated in the case of this scale, too. Descriptives and internal consistency are presented in Table 1.

Table 1

Sample sizes, empirical ranges, means, standard deviations, skewnesses, kurtosises, and Cronbah's alpha statistics: DASS21, ERQ, SSMIS-SF, and BMSLSS

	N	Min	Max	*M*	*SD*	Sk	Ku	α
DASS-21								
Depression	386	0	3	0.81	0.64	0.77	-0.31	.86
Anxiety	386	0	3	0.74	0.69	0.94	0.22	.81
Stress	386	0	3	1.18	0.75	0.24	-0.94	.83
ERQ								
Cognitive reappraisal	386	1	7	4.02	1.41	-0.22	-0.45	.77
Expressive suppression	386	1	7	3.47	1.51	0.12	-0.82	.72
SSMIS-SF	373	1	9	3.85	1.27	0.41	0.74	.52
BMSLSS	364	2	7	5.58	1.13	-0.87	0.38	.82

Note. DASS-21 = Depression, Anxiety, and Stress Scale; ERQ = Emotion Regulation Questionnaire; SSMIS-SF = Self-Stigma of Mental Illness Scale – Short Form; BMSLSS = Brief Multidimensional Students' Life Satisfaction Scale.

Ethical Standards

This study was reviewed and approved by the Committee for Assessment of Ethicality in Scientific Research of the Institute for Educational Research in Belgrade, Serbia (No. 163/2023).

Results

Descriptive statistics

Sample sizes, empirical ranges, means, standard deviations, skewnesses, and kurtosises for DASS21, ERQ, SSMIS-SF, and BMSLSS are presented in Table 1. The majority stated their physical health is good (39.7%) or very good (49.9%). When it comes to mental health, an average of 4.21 (*SD* = 0.91) is significantly higher than the average score of 3 ($t(384) = 38.457$, $p < .001$), with 29.8% stating their mental health was good and 48.3% very good. Of all participants, 46.4% knew someone with mental health issues, with 8.9% being that person.

Additionally, average scores for seeking mental health information and being informed were analyzed. For seeking mental health information, the average score was 3.12 (*SD* = 1.21), which does not deviate significantly from the average score of 3. For being informed, the mean score ($M = 3.43$, $SD = 1.10$) was higher than the mean score of 3 ($t(384) = 7.806$, $p < .001$). Descriptive statistic measures of all items of MHLq-yp are presented in Appendix A and all items in Serbian, as well as the scoring procedure, are presented in Appendix B. When it comes to recognizing mental health disorders, the percentage of affirmative answers is presented in Appendix C. To explore significant differences between percentages, z scores were used. Among mental disorders, differences were found between all proportions, except between schizophrenia and depression. Among other disorders, differences were found between Parkinson's disease and Down syndrome ($z = -4.986$, $p < .001$); cerebral palsy and Down syndrome ($z = -5.150$, $p < .001$), and stroke and Down syndrome ($z = -3.769$, $p < .001$).

Developing a short version: Factor analysis and internal consistency reliability

Following the three-factor model proposed by the original scale authors, CFA conducted in JASP software (Version 0.13.1, University of Amsterdam) indicated a poor fit to our data ($\chi^2(528, 495) = 1414.728$, $p < .001$, RMSEA = .070, and CFI = .655). To explore the 33-item Serbian scale

further, EFA with principal axis factoring and oblique promax rotation was conducted, guided by previous research suggesting intercorrelated factors (Campos et al., 2016). The number of factors to extract was determined using the parallel analysis method (PC), and items with loadings below 0.4 were excluded (Stevens, 2002).

The KMO coefficient (0.82) and Bartlett test ($\chi^2(528) = 3179.911$, $p < .001$) indicated that the data were suitable for EFA, which yielded a four-factor solution accounting for 30.1% of the variance (Figure 1). Table 2 presents the factor loadings for each item. Items 1, 7, 13, 15, 16, 18, 20, 27, and 32 were excluded from the final version due to factor loadings below 0.4. The first factor ($\lambda = 5.933$), explaining 15.9% of the variance, consisted of 9 out of 18 items that were originally part of the factor Knowledge and stereotypes; the second factor ($\lambda = 3.052$), accounting for 7.2% of the variance, included 6 out of 10 items from the initial First Aid and Help-seeking factor; factor number three ($\lambda = 2.098$) explaining 4.2% of the variance, contained 5 items which are distributed in different factors in the original version; and the fourth factor ($\lambda = 1.558$) which accounted for 2.7% of the variance comprised 5 items with all but one (item 14) originating from the Self-help factor. Thus, three factors containing the same items as factors of the original version were also named the same: "Knowledge/Stereotype (Factor 1)," "First aid skills and Help-seeking (Factor 2)," and "Self-help strategies (Factor 4)." However, factor three from a four-factor solution overlapped with other factors both empirically and conceptually. Items 12 (*People with mental disorders come from families with little money*), 17 (*Only adults have mental disorders*), and 26 (*Depression is not a true mental disorder*) are about wrong beliefs about people with mental health disorders and the disorders themselves. All three items are included in the Knowledge/Stereotype factor in the original version of the questionnaire. As shown in Table 3, factor three is the most correlated with the first - Knowledge/Stereotype. However, item 24 (*If a friend of mine developed a mental disorder, I wouldn't be able to help her/him*) describes a belief about one's capacity to help a friend who is dealing with a mental health disorder. In the original version of the questionnaire, this item is included in the Self-help strategies factor. As we consider this factor to be conceptually contradictory, containing different kinds of beliefs about mental health, and

as the study aim was to make a shorter version of the questionnaire, it was decided for the factor three to be excluded. Despite its strong loading, item 14 ("*Alcohol use may cause mental disorders*") was removed from the Self-help strategies factor due to its better conceptual fit with the Knowledge factor. Factors moderately correlate, with the highest correlation being between First aid skills and Help-seeking and Self-help strategies (.54) and the lowest between Knowledge/Stereotype and First-aid skills and Help-seeking (.18) (Table 3).

Figure 1

Scree plot for the first exploratory factor analysis of the MHLq-yp

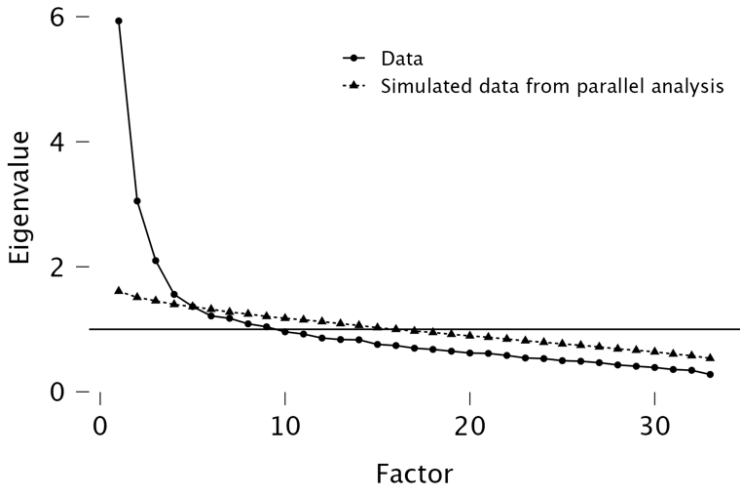


Table 2

Factor loadings

	1st EFA Factors				2nd EFA Factors		
	1	2	3	4	1	2	3
Item11	0.710				0.719		
Item 31	0.608				0.663		
Item 4	0.604				0.511		
Item 23	0.587				0.555		
Item 28	0.564				0.664		
Item 25	0.533				0.427		
Item 22	0.459				0.486		
Item 3	0.416						
Item 33	0.412				0.495		
Item 10		0.804				0.782	
Item 6		0.639				0.621	
Item 8		0.589				0.539	
Item 5		0.520				0.561	
Item 19		0.507				0.468	
Item 29		0.498				0.438	
Item 12			0.656				
Item 17			0.652				
Item 24			0.482				
Item 26			0.422				
Item 21				0.606			0.610
Item 14				0.533			
Item 30				0.478			
Item 2				0.434			0.481
Item 9				0.422			0.447
Item 1							
Item 7							
Item 13							
Item 15							
Item 16							
Item 18							
Item 20							
Item 27							
Item 32							
R^2	30.1				32.7		

Note. Loading not presented in the tables are low factor loadings (< 0.4).

Table 3

Intercorrelations between factors after the first and the second EFA

	1st EFA				2nd EFA		
	Factors				Factors		
	1	2	3	4	1	2	3
1	-				-		
2	.18	-			.23	-	
3	.48	.18	-		.37	.47	-
4	.41	.54	.23	-			

Note. The first EFA: Factor 1 (Knowledge/Stereotype); Factor 2 (First aid skills and Help-seeking); Factor 4 (Help-seeking and Self-help strategies). In the second EFA: Factor 1 (Knowledge/Stereotype); Factor 2 (First aid skills and Help-seeking); Factor 3 (Help-seeking and Self-help strategies).

Since EFA showed that the factor structure of the Serbian version of the MHLq-yp is not unidimensional, reliability coefficients for total scores (for both 33 and 20 items versions) are mainly calculated for comparison with the original version of the questionnaire and comparison of these two Serbian versions. Both versions of the scale showed good reliability (Table 4). The subscale coefficients did not decrease significantly after reducing the number of items. However, the Serbian version of the SHS subscale, consisting of 5 items, had questionable reliability. Thus, despite its low loading, item 32 was retained within this subscale because the reliability coefficient drops to 0.59 if this item is removed. This suggests that the Serbian version of the SHS subscale requires further refinement to improve its reliability.

Table 4

Comparison of Cronbach's alpha coefficients

	Campos et al. (2016)	Original scale Serbian	Shortened version Serbian
Number of items	33	33	20
Knowledge/Stereotype	.78	.79	.79
First aid skills and Help-seeking	.79	.75	.74
Self-help strategies	.72	.65	.61
MHLq-yp	.84	.83	.81

Note. MHLq-yp= Mental Health Literacy Questionnaire for Young People – Serbian Shortened Version, total score.

Finally, the mean values of the three subscales and total scores are calculated based on the results of EFA. Descriptive statistics and correlations are presented in Table 5. All scores are significantly higher than the average score 3: Kn/St ($t(385) = 26.021$, $p < .001$); FA/HS ($t(385) = 17.526$, $p < .001$); SHS ($t(385) = 21.772$, $p < .001$); total MHLq-yp score ($t(385) = 30.085$, $p < .001$).

Table 5

Means, standard deviations, and Spearman's rho correlations among MHLq-yp dimensions and total score

	M	*SD*	Sk(z)	Ku(z)	Kn/St	FA/HS	SHS
Kn/St	3.86	0.66	-6.55	5.70	-		
FA/HS	3.74	0.83	-4.92	-0.73	.08	-	

SHS	3.79	0.71	-4.19	1.91	.28**	.36**	-
MHLq-yp	3.81	0.53	-8.01	9.03	.66**	.70**	.69**

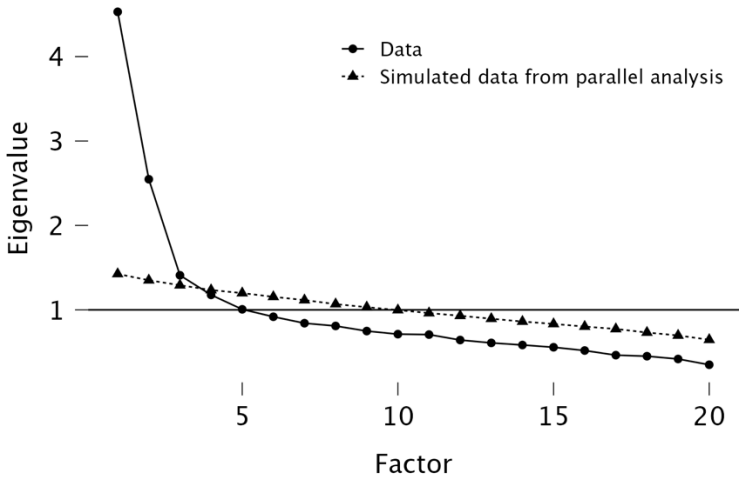
Note. Kn/S t= Knowledge/Stereotype; FA/HS = First aid skills and Help-seeking; SHS = Self-help strategies; MHLq-yp = Mental Health Literacy Questionnaire for Young People – Serbian Shortened Version.
* $p < .05$. ** $p < .01$.

The Serbian short version of the MHLq-yp contains three factors: Knowledge/Stereotype (items 3, 4, 11, 22, 23, 25, 28, 31, 33), First aid skills and Help-seeking (items 5, 6, 8, 10, 19, 29), and Self-help strategies (items 2, 9, 21, 30, 32). The second EFA is then performed on these 20 items. The KMO coefficient (0.83) and Bartlett test ($\chi^2(190) = 1771.738$, $p < 0.001$) indicated that the data were suitable for EFA. A three-factor solution was yielded, accounting for 32.7% of the variance (Figure 2). The second part of Table 2 presents the factor loadings for each item. The first factor (λ=4.530), explaining 15.7% of the variance, consisted of 8 out of 9 items that were chosen to be retained within the factor Knowledge and stereotypes. Item 3 (*A person with depression feels very miserable*) had a low loading on the first factor (0.34). However, compared to the loadings of this item on the other factors, this loading was the highest. The second factor (λ = 2.547) accounting for 10.8% of the variance included all six items we retained within the factor First Aid and Help-seeking. Factor number three (λ=1.41) explained 6.2% of the variance, containing only three out of five retained items within the Self-help strategies factor. The loading of item 30 (*Doing something enjoyable helps to improve mental health*) on factor three was lower than 0.4 (0.371) but still higher than its loadings on other factors. Finally, item 32 (*Talking over problems with someone helps to improve mental health*) has a loading lower than 0.3, which was expected, taking into account that it is retained within this scale based on reliability analyses despite low loading in the first EFA. Based on the second EFA, we decided to retain all 20 items in the short version. To conclude, the short Serbian version

of MHLq-yp yielded a three-factor structure and showed good reliability, but the SHS scale should be further explored and improved.

Figure 2

Scree plot for the second exploratory factor analysis of the MHLq-yp



Convergent Validity: Correlates and group differences

To assess convergent validity, correlations were examined between the MHLq-yp dimensions and total scores with measures of depression, anxiety, stress, cognitive reappraisal, expressive suppression, personal stigma towards individuals with mental health issues, satisfaction with life in various domains, self-perceived mental health, frequency of seeking mental health information, and level of general mental health knowledge. Due to non-normal distributions, Spearman's rho correlations were utilized. Findings are detailed in Table 6.

Table 6

Correlations between MHLq-yp dimensions and MHLq-yp total score and different factors

Scale	Kn/St	FA/HS	SHS	MHLq-yp
DASS21				
Depression	.28**	-.18**	-.02	.03
Anxiety	.31**	-.19**	-.03	.05
Stress	.29**	-.18**	.00	.05
ERQ				
Cognitive reappraisal	.11*	.13*	.20**	.21**
Expressive suppression	.21**	-.09	.03	.05
SSMIS-SF	.13*	.02	.09	.11*
BMSLSS	-.25**	.24**	.13*	.03
Mental healh	-.24**	.30**	.01	.05
Seeking info	.16**	.04	.06	.13**
Informed	.14**	-.03	.01	.05

Note. Kn/St = Knowledge/Stereotype; FA/HS = First aid skills and Help-seeking; SHS = Self-help strategies; MHLq-yp = Mental Health Literacy Questionnaire for Young People – Serbian Shortened Version; DASS21 = Depression, Anxiety, and Stress Scale; ERQ = Emotion Regulation Questionnaire; SSMIS-SF = Self-Stigma of Mental Illness Scale – Short Form; BMSLSS = Brief Multidimensional Students' Life Satisfaction Scale; Mental health = Participants' assessment of their mental health; Seeking info = Participants' assessment of how often they seek information about mental health; Informed = Participants' assessment of how much they are informed about mental health in general. * $p < .05$. ** $p < .01$.

To compare groups, a non-parametric test was employed due to the non-normal distribution of dependent variables. A Mann-Whitney U test was conducted to examine differences in total MHL score and subscores by gender and whether participants knew someone with mental health issues (Table 7). The results showed that girls had significantly higher Knowledge/Stereotype scores (U = 12121, z = -5.06, $p < .001$) and total

scores (U = 14005, z = -3.24, p < .001) than boys. Participants who knew someone with mental health issues had significantly higher Knowledge/Stereotype scores (U = 6673, z = -2.03, p = .042) but significantly lower First Aid Skills and Help-Seeking scores (U = 6255.5, z = -2.74, p = .006) compared to those who did not know someone with mental health issues.

Table 7

Differences in MHLq-yp dimension and total score based on gender and proximity with mental health problems

	Gender			Proximity		
	Girls	Boys		Yes	No	
	Mean Ranks			Mean Ranks		
Kn/St	213.70	157.06	**	140.72	120.33	*
FA/HS	192.62	181.55		124.95	152.41	**
SHS	192.54	181.65		138.40	125.06	
MHLq-yp	204.32	167.95	**	134.65	132.68	
N	201	173		88	179	
N total	374[a]			267[b]		

Note. Kn/St = Knowledge/Stereotype; FA/HS = First aid skills and Help-seeking; SHS = Self-help strategies; MHLq-yp = Mental Health Literacy Questionnaire for Young People – Serbian Shortened Version. *p < .05. **p < .01.

[a]. Participants who answered prefer not to answer or *other* are removed (n=11);

[b]. Participants who answered they are not sure if they know someone with mental health problems are removed (n=119).

Discussion

This study aimed to translate and adapt the MHLq for young people into Serbian, explore its factor structure, create a shorter version, and assess its internal consistency and external validity.

The majority of respondents rated their mental health above average, i.e., as very good or good. At the same time, nearly half of the participants stated that they know someone with mental health problems, mostly friends. Among mental health disorders, the smallest percentage of participants

accurately identified generalized anxiety as a mental disorder, compared to depression and schizophrenia. Previous studies showed young people to have very low percentages of successfully identifying mental disorders (Aluh et al., 2018; Coles et al., 2016; Gulliver et al., 2010; Jorm, 2007; Lam, 2014; Thai et al., 2020; Wright et al., 2005). It is important to explore why it is harder for young people to recognize general anxiety as a mental health problem and how successful they are in differentiating it from stress or nervousness. Among other medical conditions, it is notable that most issues are related to Down syndrome, which is recognized as a mental health issue more often than other medical conditions, probably due to cognitive impairments. It would be interesting to cross-check this data with data on how many people with these disorders participants know. Participants demonstrated average information-seeking behavior and knowledge about mental health. Also, participants showed a reasonable degree of MHL, including knowledge about mental health problems, self-help strategies, and using first aid and help-seeking skills. Such findings contrast with a previous Serbian study indicating lower MHL among high school students (Popić et al., 2014), in which, however, a different methodology (vignettes) was used.

Factor analysis and internal consistency analysis resulted in the shorter version of the instrument, with 20 items organized, as expected, in the original three dimensions – Knowledge/Stereotype, First aid skills, and Help-seeking and Self-Help strategies (SHS). The intercorrelations between dimensions and total score supported the questionnaire's consistency. Internal reliability was acceptable, except for the SHS subscale, which showed questionable reliability. Internal reliability for the SHS subscale might be improved in future research with the inclusion of additional items. However, at first, EFA showed a four-factor solution was the one that best fit the data, but we decided to exclude one of the factors. This factor consisted of beliefs related to mental disorders (*Depression is not a true mental disorder; Only adults have mental disorders*), people dealing with them (*People with mental disorders come from families with little money*), and beliefs about whether one would be able to help if a friend develops a mental disorder. In the original version of the questionnaire, the first three items are loaded on the Knowledge/Stereotype factor and the latter on the Self-help strategies factor. However, it is important to consider why our data did not fit

this way. It is possible that participants understood the last item in the context of their own limited resources for help (would I know who to turn to, would I have someone to ask for information), or perhaps they understood the item in the context of knowledge about mental disorders (would I understand them, would I know what their problem entails and what it looks like). Considering that all other items conceptually fit the Knowledge/Stereotype factor best, it may be the wording of the item or cultural differences. This should be further investigated using, for example, interviews or focus groups. The first three items are all about Knowledge/Stereotype, but they did not load on that factor. It would be important to explore this further with participants, asking them about their understanding of the items' meaning. Furthermore, item 14 (*Alcohol use may cause mental disorders*) was excluded because of poor conceptual fit with the Self-help strategies factor, and we consider the Knowledge/Stereotype factor to be a better conceptual fit (as is the case with the original version of the questionnaire). However, it should be noted that this item strongly loaded on the Self-help strategies factor, which raises the question about how alcohol is perceived by young adolescents in the context of mental health. Kilibarda and colleagues (2013) showed in a sample of students in Serbia that predictors for potential drinking are the expectation of having fun and the wish to feel relaxed. Along with our results, does this mean that adolescents perceive drinking as a self-help strategy? It would be important to explore this further in a separate research study.

The Knowledge/Stereotype subscale was positively correlated with depression, anxiety, and stress, while the First Aid Skills and Help-seeking subscales showed negative correlations with these measures. This suggests that individuals with heightened symptoms of psychological distress may face challenges in using these skills (Calear et al., 2021; O'Brien, 2020; Singh et al., 2020). All MHLq-yp subscales and the total score were positively correlated with cognitive reappraisal, indicating that greater knowledge about mental health and treatment options may lead individuals to be better equipped to understand and manage their emotions (Tambling et al., 2023; Zhang et al., 2023). However, only the Knowledge/Stereotypes subscale showed a significant positive correlation with expressive suppression. It is possible that this correlation reflects the avoidance of content that we seek or are exposed to, but that is also unpleasant, so we may tend to avoid or

suppress those feelings. Previous studies showed that cognitive reappraisal can effectively mitigate one's subjective experience of negative emotion, while the effect of expressive suppression is controversial (Yan et al., 2022). Surprisingly, the Knowledge/Stereotype subscale and MHLq-yp total score were positively correlated with personal stigma toward individuals with mental health problems, contrary to previous research suggesting a decrease in stigma with higher MHL levels (Calear et al., 2021; Jung et al., 2017; Simões de Almeida et al., 2023). This discrepancy underscores the need to explore social and cultural factors influencing knowledge and stigma surrounding mental health, especially in less developed countries like Serbia, where low levels of mental health knowledge, high stigma, and limited confidence in healthcare services prevail (Renwick, 2022).

Knowledge/Stereotypes subscale correlated negatively, while the First Aid Skills and Help-seeking and Self-Help Strategies subscales correlated positively with the self-perceived satisfaction with life in multiple domains. Such findings are partly in line with previous results linking better MHL and adolescents' well-being (Ethan & Patricia, 2021; Zhang et al., 2023). However, different directions of these correlations raise questions about using the total MHL score when accessing MHL. A higher score on the Knowledge/Stereotypes scale was associated with poorer self-evaluated mental health in this study, contradicting prior research (Jafari et al., 2021). This may be because greater knowledge leads to recognizing more symptoms, negatively impacting self-rated mental health. The Knowledge/Stereotype subscale and MHLq -yp total score were also positively correlated with participants' self-reported frequency of seeking information about mental health, emphasizing the importance of promoting MHL to encourage individuals to seek information and potentially improve mental health outcomes (Ghadirian & Sayarifard, 2019; Gulliver et al., 2010).

Our results indicate that girls score higher on Knowledge/Stereotype and overall Mental Health Literacy (MHL) compared to boys, which is in line with previously reported results (e.g., Nobre et al., 2022; Ozturan & Kocakaya, 2023; Ratnayake & Hyde, 2019). However, some studies found higher MHL levels in men, particularly in communities with better access to education and media for males (Bener & Ghulom, 2011). Our results also show that respondents who pointed out that knowing someone with a mental

health problem achieved higher scores on the Knowledge/Stereotype subscale and lower scores on the First Aid Skills and Help-seeking subscale. Similar results were found in several studies (Campos et al., 2016; Dias et al., 2018; Jorm, 2000; Lauber et al., 2001; Nobre et al., 2022). Improving help-seeking behaviors is crucial for adolescents, with interventions showing increased formal help-seeking (Lubman et al., 2020). Enhancing MHL parents and adolescents may lead to improved mental health support for adolescents, who are more likely to seek help from parents and peers than mental health professionals (Calear et al., 2021).

Assessing MHL is vital for preventing, identifying, and treating mental health issues. The MHLq-yp (short version) serves as a valuable screening tool, particularly in school settings, offering a reliable self-report measure rooted in a comprehensive MHL approach. Future research should further investigate the psychometric properties of the MHLq-yp short form with diverse adolescent samples.

Limitations and future directions

Considering the age of participants and the paper-and-pencil method we used for collecting data, the percentage of excluded participants due to missing values was at the level expected by the researchers (about 9%). However, it is possible that this was not completely random but related to MHLq-yp - the participants with lower MHLq-yp scores may have had difficulties answering other questions related to mental health. This issue could be further explored in future research using focus groups or interviews. Furthermore, the data on knowing someone with mental health problems (families/relatives/friends/themselves) rely on participants' own assessments of disorders' presence, which are not reliable, so these results should be interpreted with caution. Although the BMSLSS demonstrated high reliability, it was not previously validated in Serbia, and the reliability of the SSMIS-SF is questionable. Future research should include additional questionnaires that have been validated in Serbian samples of children and adolescents. The main problem, which was noted in the Results and Discussion sections, is related to the SHS scale. Low factor loadings should be further explored in future research, and the development of additional items should be considered. Suggestions for future research are also

mentioned in the Discussion section, but it is important to add that a multi-method approach and a more diverse sample of participants could be used in future research. However, as far as we know, this is the first study that validated the scale for assessment of MHL in elementary school students in Serbia.

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Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data used in this paper are available upon a reasonable request.

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Appendix A

Table A1

Means, standard deviations, skewness, and kurtosis for all items

	Items	*N*	*M*	*SD*	Skewness (z)	Kurtosis (z)
1	If a friend of mine developed a mental disorder, I would offer her/him support.	383	4.51	0.84	-2.14	5.02
2	Physical exercise helps to improve mental health.	383	4.02	1.14	-1.00	0.13
3	A person with depression feels very miserable.	380	3.80	1.13	-0.58	-0.45
4	People with schizophrenia usually have delusions (e.g., they may believe they are constantly being followed and observed).	371	3.91	1.07	-0.83	0.26
5	If I had a mental disorder I would seek my family's help.	385	4.11	1.27	-1.25	0.33
6	If a friend of mine developed a mental disorder, I would encourage her/him to look for a psychologist.	381	4.25	1.08	-1.65	2.22
7	Mental disorders don't affect people's behaviours.	381	4.0	1.26	-1.07	0.03
8	If a friend of mine developed a mental disorder, I would talk to her/his parents.	382	3.24	1.37	-0.26	-1.09
9	Good sleep helps to improve mental health.	384	3.68	1.20	-0.63	-0.41

10	If I had a mental disorder I would seek for professional help (psychologist and /or psychiatrist).	383	3.87	1.31	-0.96	-0.23
11	A person with anxiety disorder may panic in situations that she/he fears.	369	4.00	1.06	-1.09	0.88
12	People with mental disorders come from families with little money.	378	4.19	1.03	-1.05	0.26
13	If a friend of mine developed a mental disorder, I would listen to her/him without judging or criticising.	382	4.42	0.98	-1.90	3.18
14	Alcohol use may cause mental disorders.	384	3.87	1.19	-0.88	-0.10
15	Mental disorders don't affect people's feelings.	385	4.04	1.27	-1.12	0.11
16	The sooner mental disorders are identified and treated, the better.	383	4.47	0.92	-2.00	3.67
17	Only adults have mental disorders.	385	4.60	0.80	-2.34	5.66
18	Brain malfunctioning may cause the development of mental disorders.	376	3.77	1.00	-0.57	0.06
19	If a friend of mine developed a mental disorder, I would encourage her/him to get medical support.	385	3.97	1.11	-0.94	0.19
20	If I had a mental disorder I would seek my friends' help.	383	3.49	1.30	-0.47	-0.88

21	Having a balanced diet helps to improve mental health.	384	3.27	1.18	-0.24	-0.63
22	One of the symptoms of depression is the loss of interest or pleasure in most things.	379	4.01	1.10	-1.11	0.72
23	A person with anxiety disorder avoids situations that may cause her/him distress.	376	3.75	1.09	-0.67	0.03
24	If a friend of mine developed a mental disorder, I wouldn't be able to help her/him.	382	3.94	1.16	-0.94	0.05
25	The symptoms' length is one of the important aspects to determine whether a person has, or has not, a mental disorder.	360	3.39	0.98	-0.11	0.02
26	Depression is not a true mental disorder.	382	3.86	1.31	-0.90	-0.32
27	Drug addiction may cause mental disorders.	381	4.25	1.01	-1.45	1.74
28	Mental disorders affect people's thoughts.	382	4.18	0.96	-1.11	0.78
29	If a friend of mine developed a mental disorder, I would talk to the form teacher or other teacher.	383	3.02	1.40	-0.13	-1.23
30	Doing something enjoyable helps to improve mental health.	381	3.98	1.03	-0.95	0.58
31	A person with schizophrenia may see and hear things that nobody else sees and hears.	379	3.88	1.12	-0.82	0.03

32	Talking over problems with someone helps to improve mental health.	383	4.01	1.01	-1.01	0.77
33	Highly stressful situations may cause mental disorders.	382	3.92	1.10	-0.83	-0.04

Note. Both theoretical and empirical range for all items is from 1 to 5.

Appendix B

Table B1

Items of Serbian Short Version of Mental Health Literacy Questionnaire for Young People (MHLq_yp)

1	Физичка активност помаже да ментално здравље буде боље.
2	Особа са депресијом се осећа веома јадно.
3	Особе са шизофренијом обично имају илузије (на пример, верују да их неко стално прати и посматра).
4	Да ја имам ментални поремећај, потражио/ла бих помоћ од своје породице.
5	Да мој друг/другарица развије ментални поремећај, охрабрио/ла бих га/је да потражи помоћ психолога.
6	Да мој друг/другарица развије ментални поремећај, разговарао/ла бих са његовим/њеним родитељима.
7	Добар сан помаже да ментално здравље буде боље.
8	Да ја имам ментални поремећај, тражио/ла бих професионалну помоћ (психолога и/или психијатра).
9	Особа са анксиозним поремећајем може паничити у ситуацијама којих се она плаши.
10	Да мој друг/другарица развије ментални поремећај, подстакао/ла бих га/је да потражи медицинску помоћ.
11	Балансирана исхрана помаже да ментално здравље буде боље.
12	Један од симптома депресије је губитак интересовања или уживања у већини ствари.
13	Особа са анксиозним поремећајем избегава ситуације које могу да је узнемире.

14	Трајање симптома је један од важних аспеката за одређивање тога да ли неко има или нема ментални поремећај.
15	Ментални поремећаји утичу на мисли које људи имају.
16	Да мој друг/другарица развије ментални поремећај, разговарао/ла бих са разредним/ом или неким другим наставником.
17	Када радимо нешто у чему уживамо, то може да нам поправи ментално здравље.
18	Особа са шизофренијом може видети и чути ствари које нико други не види и не чује.
19	Разговор са неким о својим проблемима помаже да ментално здравље буде боље.
20	Изузетно стресне ситуације могу довести до менталних поремећаја.

Note. Knowledge/Stereotype - item9, item18, item3, item13, item14, item15, item12, item2, item20); First Aid and Help-seeking – item8, item5, item6, item4, item10, item16 and Self-Help strategies – item1, item7, item11, item17, item19.

Appendix C

Table C1

Recognizing mental health problems – Percentage of affirmative answers in additional questions of MHLq-yp

	Yes(*N*, %)	*N*
Generalised anxiety	201, 56.0%	359
Depression	272, 75.3%	361
Schizophrenia	269, 74.9%	359
Parkinson's desease	65, 18%	361
Cerebral palsy	63, 17.5%	360
Stroke	78, 21.7%	360
Down syndrome (Trisomy 21)	124, 34.3%	362

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Research Article

Traditional and Computer-Based Assessment of Executive Functions

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ABSTRACT

This study aimed to assess the psychometric properties of two newly developed computer-based tasks (i.e., Mental Shifting/Flexibility Task and Auditory-Visual Go/No-Go Task) for measuring two key domains of executive functions (EF) - inhibition and mental shifting (flexibility) - in healthy adults. Together with these tasks, traditional paper-and-pencil tests were used for assessing construct validity (Wisconsin Card Sorting Test - WCST, Trail Making Test - TMT, Verbal Fluency Tests, and Advanced Progressive Matrices- APM). The sample consisted of 468 adult twins (70.7% female, mean age 24.06 years) or 234 twin pairs. Results revealed low to moderate correlations between the reaction times and the number of errors in the computer-based tasks and traditional tests. Specifically, the Mental Shifting/Flexibility Task showed significant correlations with the TMT and the WCST. The Auditory-Visual Go/No-Go Task was significantly related to TMT and APM, suggesting shared cognitive processes linked to inhibition, cognitive flexibility, and processing speed. The computer-based tasks demonstrated moderate to good ICC reliability, especially in reaction time measures, while error rates showed poorer reliability. It was concluded that computer-based tasks are useful for measuring executive functions. However, further validation, development of standardized norms, and optimization of these tools are needed. Future research should explore how these tools can be integrated into existing cognitive assessment batteries for

more accurate measurement of executive functions across diverse populations and clinical contexts.

Keywords: Computer-based assessments, Executive functions, Psychometric properties, Cognitive flexibility, Inhibition

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Introduction

Executive functions (EFs) refer to a set of cognitive processes involved in the control, regulation, and management of other cognitive activities. These functions allow individuals to plan, initiate, monitor, and adjust their behavior to achieve goals (Miyake et al., 2000). Initially viewed as a unified construct, research now conceptualizes EFs as a hierarchical framework comprising several lower-order functions (e.g., Diamond, 2013). Miyake's model, one of the most influential models of executive functions, identifies three core components crucial for goal-directed behavior: 1) inhibition, the ability to suppress automatic responses in favor of more appropriate actions; 2) shifting (cognitive flexibility), the ability to switch between tasks or strategies; and 3) updating, which involves maintaining and refreshing relevant information in working memory. These components are measured as latent variables inferred from multiple tasks or indicators (Miyake et al., 2000).

Traditional methods for assessing executive functions (EFs) include structured paper-and-pencil tests, clinical interviews, and behavioral observations. Well-known tools include the Wisconsin Card Sorting Test (WCST; Heaton et al., 1993), measuring cognitive flexibility and rule-shifting; the Stroop Test (Golden, 1978), assessing selective attention and inhibition; the Trail Making Test (TMT; Reitan, 1955), measuring attention and task-switching; and the Verbal Fluency Test (Goodglass & Kaplan, 1983), assessing cognitive flexibility and lexical access. Although paper-based tests have a long history and are widely accepted, they have significant drawbacks. These tests are time-consuming for clinicians to administer and score, lack flexibility in modifying tasks or stimuli, and provide limited outcome measures (Miller & Barr, 2017; Vermeent et al., 2020). While paper-based tests are supported by normative data, newer digital cognitive tests offer more efficient and flexible alternatives (e.g., Feenstra et al., 2017; Kessels, 2019; Riordan et al., 2013).

Computer-based assessment of EFs offers several advantages: 1) standardization and objectivity – it reduces human error by standardizing test administration and minimizing variability in scoring and participant interaction; 2) efficiency – these tests are faster to administer, with automated scoring and quicker result interpretation; 3) interactivity – they

can incorporate various stimuli (visual, auditory, tactile), enabling a broader EF assessment; 4) precision – real-time performance monitoring enhances accuracy in measuring reaction times and task-solving speed; 5) accessibility – these tests can be used in multiple settings, including remote ones, offering greater scalability (Kane & Kay, 1992; Schatz & Browndyke, 2002). Commonly used computer-based tests include computerized versions of the WCST (Tien et al., 1996), Stroop Test (Capovilla et al., 2005), the N-back Task (Jacola et al., 2014), the Iowa Gambling Task (Dancy & Ritter, 2017), the Tower of London Task (Tybursku et al., 2021), the Go/No-Go Task (Tybursku et al., 2021), and the Flanker Task (Sanders et al., 2018).

Additionally, computer-based testing with simple cognitive tasks offers more precise measurements of EF processes, focusing on specific components like inhibition, shifting, and working memory updating. Unlike traditional tests such as the WCST and Tower of Hanoi, which suffer from "task impurity" due to non-EF factors (e.g., visual-spatial processing, memory), computer-based tasks have clearer theoretical foundations and higher reliability (Miyake et al., 2000). However, traditional tests remain crucial in clinical settings, providing valuable diagnostic insights. Thus, computer-based tasks should complement, not replace, traditional assessments.

In addition to the advantages of computer-based tests, research has focused on validating these tasks for assessing executive functions. A meta-analysis showed a strong correlation of .91 between computerized and paper-based cognitive ability tests, with higher correlations for timed power tests compared to speeded tests (Mead & Drasgow, 1993). Studies have confirmed the equivalence of computer-based and traditional versions of the WCST in healthy adults (Tien et al., 1996; Wagner & Trentini, 2009) as well as in elderly populations (Collerton et al., 2007). Similarly, the digital version of the TMT showed strong correlations with its traditional counterpart, discriminating effectively between younger and older adults (Park & Schott, 2022). However, the digital TMT required more time in older adults, likely due to cognitive load and technology familiarity (Latendorf et al., 2021). Research has also suggested that computer familiarity can modestly affect performance (McDonald, 2002). While most studies confirm the equivalence between computer-based and traditional cognitive tests (e.g., Park & Schott,

2022), some report discrepancies, highlighting the need for deeper insight into the psychometric properties of these tests (Steinmetz et al., 2010). Computer-based tasks have demonstrated convergent validity, showing strong correlations with traditional measures of cognitive flexibility and intelligence. Tasks like the Flanker Task and Tower of London are well-correlated with the WCST, Digit Span, Stroop Test, and TMT (Miyake et al., 2000). Similarly, the N-back task, used for working memory, correlates strongly with traditional neuropsychological tests (Miyake et al., 2000). However, in older adults, N-back performance is more linked to attention and memory functions than executive control, with attentional switching and updating being the most consistent cognitive functions across age groups (Gajewski et al., 2018).

Despite their advantages, computer-based methods face challenges, particularly in terms of psychometric properties like reliability and construct validity. Technological factors such as cognitive load, screen fatigue, and limited access to technology can affect performance (Alloway & Carpenter , 2020). Further research is needed to validate these methods, especially in relation to demographic and cultural factors that may influence results. While studies by Wagner and Trentini (2009) and Latendorf et al. (2021) support the reliability and sensitivity of computer-based assessments, additional validation is still required.

The Current Study

While computer-based assessment tools have demonstrated potential as valuable complements to traditional tests, their rigorous validation is crucial as new tasks continue to emerge. This study aims to assess the psychometric characteristics of newly developed computer-based tests for executive functions in healthy adults, specifically focusing on their internal consistency and construct validity. To validate these tasks, the study compares them to traditional neuropsychological assessment tools (e.g., Wisconsin Card Sorting Test, Trail Making Test), ensuring that the computer-based tools meet the same high standards for reliability and validity. Building on prior research, we hypothesize that these computer-based tasks will show moderate to strong correlations with traditional tests assessing cognitive flexibility, inhibition, and processing speed. These

hypotheses are informed by previous findings indicating robust links between computerized and paper-based assessments of executive functions (e.g., Tien et al., 1996; Park & Schott, 2021).

Furthermore, this study aims to contribute theoretically by offering a deeper understanding of the cognitive processes underlying executive functions. By examining the relationships between different executive functions—such as inhibition and cognitive flexibility—this research seeks to shed light on how these processes interact in healthy adults, thereby advancing our knowledge of cognitive control mechanisms and their measurement.

Method

Participants and Procedure

A total of 468 participants, comprising 234 twin pairs, took part in the study. The majority of participants were female (70.71%), with an average age of 24.06 years (*SD* = 7.02). Regarding zygosity, most pairs were monozygotic (65.38%). Among dizygotic twin pairs, the majority (55.56%) were same-sex pairs. Detailed characteristics of the sample can be found in Appendices A and B. The Serbian Advanced Twin Registry (STAR) has established a comprehensive framework for recruitment, testing, and data collection, as described in detail by Smederevac et al. (2019). Procedures for determining twins' zygosity are outlined in Mitrović et al. (2024). Ethical approval for the study was obtained from the Institutional Ethical Committees under the codes #02-374/15, #01-39/229/1, and #O-EO-024/2020. Participation was entirely voluntary, with all participants signing informed consent forms prior to testing. Participants who volunteered were invited to attend an in-person assessment. Each measure used in this research was administered individually. The data utilized in this study were gathered over the period from 2012 to 2024.

Measures

Computer-Based Executive Functions Tasks

Mental Shifting/Flexibility Task

This task primarily measures mental shifting (flexibility) - the ability to efficiently shift attention between tasks or mental sets (Allport & Wylie, 1999; Friedman et al., 2008; Miyake et al., 2000). This involves deactivating one set and activating another based on task demands and overcoming proactive interference when new operations are hindered by previous ones. It consists of five progressively complex blocks, each increasing in complexity according to the demands placed on the participants. Each block contains 39 trials, consisting of letters (A, G, U, ...), numbers (1, 6, 7, ...), and symbols (?, *, ;, #, ...) in various colors (there were 13 combinations of stimuli). Participants were instructed that different letters, numbers, and symbols would appear alternately on the screen in different colors. Their task was to press one of the mouse buttons according to the instructions provided before the start of each block. Participants were also instructed to perform the tasks as quickly and accurately as possible. As with the first task, participants underwent a brief practice session (10 trials) before beginning the series of five blocks: 1) in the first block, participants were instructed to press the right mouse button if a letter, number, or symbol appeared in blue, and to press the left mouse button in all other situations; 2) in the second block, participants were instructed to press the right mouse button if a letter appeared, and to press the left mouse button in all other situations; 3) in the third block, participants were instructed to press the right mouse button if a number in red appeared, and to press the left mouse button in all other situations; 4) in the fourth block, participants were instructed to press the right mouse button if an odd number appeared, and to press the left mouse button in all other situations; 5) in the fifth and final block, participants were instructed to press the right mouse button if a yellow vowel appeared (A, E, i, U), and to press the left mouse button in all other situations. Instead of I, the lowercase letter i was used so as not to interfere with the number one (1), and O was not used so as not to interfere with zero (0). Therefore, each block introduces a new instruction and task demand, requiring shifts between symbols (letters, numbers, signs) and their characteristics (color, even-odd,

consonant-vowel). The following variables were used in the study: average reaction time (RT) and the number of errors in each block, with faster responses and fewer errors indicating a better shifting ability.

Auditory-Visual Go/No-Go Task

This task is a variant of the standard Go/No-Go task (Garavan et al., 1999) and assesses the inhibition function, which is the ability to suppress automatic or dominant responses when necessary. The task consists of three blocks, each containing 40 trials, with progressively increasing complexity across the blocks. The stimuli are arrows pointing left or right (← or →), with or without accompanying sound. Participants were instructed to press one of two mouse buttons according to the instructions given before the start of each block. They were also instructed to perform the tasks as quickly and accurately as possible. Before starting the series of blocks, participants underwent a practice block (10 trials). In the first block, participants had to press the left button if the arrow pointed left and the right button if the arrow pointed right. During the second block, they were instructed to press the left button if the arrow pointed left and was accompanied by sound and the right button if the arrow pointed right and was accompanied by sound. In all other situations (left and right arrows without accompanying sound), participants were not to press any button. The critical signals (silent arrows) appear in a 16:40 ratio, in a pseudo-random order. After the stimulus duration of 500 ms, the next stimulus appeared. The third block required participants to press the right button only if the arrow pointed right and was not accompanied by sound. In all other situations (left arrow with or without sound and right arrow with sound), participants had to press the left button. The following variables were used in the study: average reaction time (RT) and the number of errors in each block, with faster responses and fewer errors indicating better inhibition ability. Note that in the second block, the correct response was not to press any button, so these correct responses were not included in the average reaction time, as they all corresponded to the maximum stimulus duration of 500 ms.

Traditional Versions of Executive Function Tests

Wisconsin Card Sorting Test (WCST; Heaton et al., 1993)

The WCST is the most well-known test for detecting perseveration and mental rigidity (the ability to form, change, and maintain sets), as well as for examining problem-solving strategies. The test assesses the ability to create and modify categorization principles through the task of classifying a series of cards according to one of three classification criteria (color, shape, and number of elements). Key measures include total errors (perseverative and non-perseverative), perseverative responses, and categories achieved, reflecting success and sorting efficiency. Additional indices include conceptual level responses (correct sequences), attempts to complete the first category, learning to learn (change in error rates), and inability to maintain a set (fewer than nine consecutive correct responses). The Total Achievement score accounts for both the number of categories and the attempts needed to identify them, emphasizing cognitive flexibility and categorization skills (Cianchetti et al., 2005).

Trail Making Test, Form A and B (TMT; Reitan, 1955, 1992; Spreen & Strauss, 1991)

TMT consists of two parts assessing different cognitive functions. Part A evaluates attention, concentration, visual perception, visuospatial processing, and visuomotor skills. It involves connecting numbered circles (1 to 25) in order, without lifting the pen, as quickly as possible. Part B also includes numbered white circles (1 to 13) and additional gray circles (1 to 12). Participants must alternate between connecting the white and gray circles in numerical order, assessing attention, executive functions, and complex conceptual tracking. Both parts measure the time taken to complete the task, with longer times indicating poorer performance.

Verbal Fluency Test (Phonemic and Semantic, see Goodglass & Kaplan, 1983; Lezak, 1995)

The Verbal Fluency Test (Phonemic and Semantic) assesses verbal fluency through 3 phonemic tasks and one semantic task. It measures the number of words produced in a set time. Phonemic fluency involves listing

words starting with a specific letter in the Serbian language (e.g., /S/, /K/, /L/) in 60 seconds, excluding repetitions, proper names, and geographical terms. Semantic fluency requires naming as many different animals as possible in one minute, avoiding repetition and irrelevant variations. These tasks also evaluate divergent thinking, as they require the participant to generate multiple solutions rather than one correct answer.

The Advanced Progressive Matrices (APM; Raven et al., 1998)

APM specifically Series II, which includes 36 tasks with a 40-minute time limit, were used to measure general intelligence (g-factor). The Raven Progressive Matrices is a non-verbal, multiple-choice test designed to assess reasoning ability, a key component of the g-factor. Participants identify the missing element that completes a pattern. The total score, derived from the number of correct answers, provides a measure of general intellectual functioning.

Data preparation and analysis

The dataset used for statistical analyses includes three groups of variables: traditional tests (N = 468), Mental Shifting/Flexibility Task (N = 324), and Auditory-Visual Go/No-Go Task (N = 428). All measures (both computerized and traditional tests) were first standardized (z-transformation) to ensure consistent variance across scales and subsequently normalized to approximate a normal data distribution. For normalization, the natural logarithmic function, ln(x + 1), was used (McElreath, 2020).

Data preparation, calculation of correlations, and estimation of intraclass correlation coefficients (ICC) were conducted using SPSS for Windows v25 (IBM Corp., 2017), while mixed-effects modeling was performed in the R programming environment v4.1.0 (R Core Team, 2020) within the integrated development environment (IDE) RStudio (RStudio, 2023). For ICC estimation, the one-way random effects model was applied following the recommendations of Shrout et al. (1979), with values interpreted based on Cicchetti (1994).

Mixed-effects models were implemented using the "nlme" package in R (Pinheiro et al., 2021) to examine the effect of a single predictor on a single criterion while accounting for the hierarchical structure of the data (i.e., membership within a twin pair). In all analyses, predictors were traditional measures of executive functions, while criterion variables were computer-based tasks. Optimal models for each case were evaluated (based on likelihood ratio tests) by including a random intercept for groups defined by the twin pair identifier, with fixed effects of the predictors compared across groups. Standardized regression coefficients (beta weights) and p-values were calculated for each predictor-criterion pair.

Results

Descriptive statistics for all measures used are presented in Appendix C. These statistics correspond to the previously described transformed scores. Based on the values of skewness and kurtosis, no significant deviations from normal distribution were observed.

Correlations between RTs across different tasks are statistically significant, positive, and of moderate strength. The number of errors across blocks of tasks generally correlates positively, although the relationships are of low intensity. Additionally, correlations between RTs and the number of errors within tasks are predominantly statistically significant, negative, and weak. A summary of these results can be found in Appendices D, E, and F. Reliability ICC values ranged from poor to good (Appendix G).

Mental Shifting/Flexibility Task

The results of the mixed-effects model analyses, where the predictor variables were scores on the traditional tests and the criterion variables were RTs and errors, are presented in Table 1. The most consistent pattern of statistically significant relationships was positive associations with TMT-A, TMT-B, and RTs. Negative relationships were found with the APM and RTs, though these were weaker in magnitude. Most other variable pairs did not exhibit statistically significant relationships. When significant relationships were observed, they were predominantly positive and of low strength.

Auditory-Visual Go/No-Go Task

Similarly, the results of the mixed-effects model analyses for the Auditory-Visual Go/No-Go Task showed positive associations with TMT-A, TMT-B, and RTs, as well as negative and moderate relationships between the APM and RTs, among the most consistent findings (Table 2). The most notable difference between the two tasks was observed in the number of errors for block 3 of the Auditory-Visual Go/No-Go Task. The number of errors from this block exhibited multiple significant (both positive and negative), albeit weak, relationships with other traditional tests. Additionally, statistically significant negative relationships were found only between RTs from the Auditory-Visual Go/No-Go Task and Semantic Fluency.

Table 1

Relationships between traditional tests of executive functions and reaction time and number of errors from the Mental Shifting/Flexibility Task

	B1 RT	B2 RT	B3 RT	B4 RT	B5 RT	B1 Er	B2 Er	B3 Er	B4 Er	B5 Er
Categories completed	-.092	.020	-.088	-.063	-.057	-.047	.062	.002	.039	-.016
Perseverative errors	.067	.042	.107*	.094	.124*	.084	.019	-.029	.011	.073
Perseverative responses	.081	.057	.117*	.103	.133**	.084	.019	-.025	.001	.080
Non-perseverative errors	.026	-.033	.017	.038	.058	.066	.009	-.033	.002	-.004
Failure to maintain set	.105*	-.040	-.092	-.022	-.063	.059	-.058	-.002	.048	.035
Trials to complete the first category	.040	.003	-.042	.015	-.020	-.025	.003	.007	.047	-.011
Total No. of correct answers	.035	-.005	-.048	-.004	-.003	.104*	.010	-.013	.008	.099*
Total No. of errors	.047	.002	.054	.060	.102*	.083	.013	-.041	-.011	.064
Conceptual level responses	-.088	.001	-.091	-.081	-.112	-.054	.034	.023	.004	-.022
Categorizing efficiency	-.084	.002	-.080	-.068	-.072	-.071	.035	.018	.029	-.053
TMT-A reaction time	.163*	.181*	.174*	.181*	.195**	.071	-.056	.013	.057	-.053
TMT-B reaction time	.251**	.261**	.161*	.230**	.168*	.106*	-.010	.024	.083	.023
Phonemic fluency	-.091	-.072	.014	-0.033	-.098	-.015	-.087	.028	-.103*	-.097
Semantic fluency	-.061	-.085	-.051	-.076	-.170**	-.045	-.032	-.039	-.024	-.086
Advanced Progressive Matrices	-.245***	-.199**	-.197**	-.253***	-.181**	-.037	-.012	-.058	.000	.003

Note. B1-B5 = block number; RT = reaction time; Er = number of errors.

*$p < .05$. ** $p < .01$. *** $p < .001$.

Table 2

Relationships between traditional tests of executive functions and reaction time and number of errors from the Auditory-Visual Go/No-Go Task

	B1 RT	B2 RT	B3 RT	B1 Er	B2 Er	B3 Er
Categories completed	-.012	.017	-.027	-.020	-.065	-.082
Perseverative errors	.062	.004	.012	.013	.048	.090
Perseverative responses	.075	.006	.010	.023	.047	.096*
Non-perseverative errors	.043	.042	-.036	.058	.046	.110*
Failure to maintain set	-.024	-.071	.010	-.008	-.029	.086
Trials to complete the first category	.014	.007	-.039	-.029	-.045	.043
Total No. of correct answers	-.009	-.028	-.004	-.008	-.034	.065
Total No. of errors	.081	.035	-.015	.037	.047	.093*
Conceptual level responses	-.038	.002	.007	-.005	-.072	-.099*
Categorizing efficiency	-.044	.006	-.011	-.021	-.061	-.094*
TMT-A reaction time	.231**	.129*	.174**	-.044	.038	-.016
TMT-B reaction time	.131*	.134*	.176**	.032	.051	.149*
Phonemic fluency	-.016	-.049	-.058	-.068	-.080	-.026
Semantic fluency	-.107*	-.054	-.128**	-.099*	-.064	-.030
Advanced Progressive Matrices	-.301***	-.148*	-.303***	-.050	-.127*	-.233***

Note. B1-B5 = block number; RT = reaction time; Er = number of errors.

*$p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

Traditional paper-and-pencil tests, like the WCST, TMT, and Verbal Fluency tests, have long been used to assess executive functions but are limited in capturing the dynamic and real-time nature of cognitive processes. These tests often suffer from 'task impurity,' where non-EF components, such as visual-spatial processing, also affect performance. Despite these limitations, traditional tests remain valuable due to their well-established psychometric properties, extensive normative data, and ability to assess executive functions in a controlled and reliable manner. They are widely used in clinical settings and have proven effective for diagnosing cognitive impairments. Computer-based tasks have been developed to address the challenges of traditional tests by providing more precise, real-time insights into specific executive functions. However, questions remain about their

reliability, validity, and comparison with traditional methods, particularly in clinical and diverse populations.

This study aims to assess the psychometric characteristics of two newly developed computer-based tests for executive functions, specifically focusing on their internal consistency and construct validity. By comparing these tools with traditional methods, we aim to determine their effectiveness in capturing the complexity of EF and their suitability for clinical and research contexts.

In this study, two computer-based tasks were developed to measure two core aspects of EF: inhibition and mental shifting. The Mental Shifting/Flexibility Task showed significant correlations with several traditional executive function measures. Notably, the computer-generated task of mental shifting/flexibility showed a positive correlation with both parts of the TMT, albeit of low intensity. The correlation was somewhat stronger for part B of the TMT, which is expected, as this part assesses more complex conceptual tracking and requires flexibility in shifting mental sets under rapid conceptual transitions (Baron, 2004). Furthermore, the observed correlations between the computer-generated task of mental shifting/flexibility and both TMT parts could be partly explained by the fact that both tasks reflect performance in terms of reaction time, suggesting that general cognitive processing speed might mediate this relationship. However, it is also possible that the connection reflects a more specific capacity for cognitive flexibility and the ability to rapidly switch between tasks or concepts rather than just processing speed.

Additionally, performance on the computer-generated mental shifting task was correlated with measures from the WCST, particularly perseverative responses and errors. Perseverative errors, which occur when a participant continues to use a previously correct sorting strategy despite feedback indicating a change in the rule, are key inverse indicators of cognitive flexibility. These errors typically happen after a rule change, when the participant fails to adapt and reverts to the old category. The correlation between this task and WCST measures suggests that mental shifting ability is linked to the capacity to inhibit previously dominant strategies and adapt to new rules.

The Mental Shifting/Flexibility Task showed correlations with APM, highlighting its connection to general intelligence and problem-solving abilities. A low but significant correlation was found between general cognitive ability and reaction time across all blocks of the task. Such findings suggest that the observed link between these constructs may, at least in part, be attributed to general cognitive processing speed. It could be that individuals with higher intelligence perform faster on shifting and inhibition tasks due to their greater overall cognitive processing speed (Horn & Noll, 1997). Also, the relationship between shifting tasks and general intelligence may reflect the shared demands on cognitive control, such as working memory and attentional control. Both general intelligence and tasks like mental shifting require rapid processing and the ability to reconfigure mental sets and adapt to new rules. Therefore, individuals with higher cognitive ability might be more efficient at deploying these cognitive resources, resulting in faster response times across a variety of tasks (Neubauer et al., 1997; Vernon & Jensen, 1984).

Furthermore, a low but statistically significant correlation was found between the first computer-generated task for mental shifting/flexibility and semantic fluency. This relationship can be explained by the shared cognitive processes between the two tasks. Semantic fluency involves searching semantic memory, switching between concepts, and inhibiting irrelevant responses, all of which require cognitive flexibility and inhibition (Swan & Carmelli, 2002; Schwartz et al., 2003; Troyer et al., 1997). The low correlation suggests that, although both tasks tap into cognitive flexibility, the specific demands—conceptual switching in semantic fluency versus rule-based shifting in the mental shifting task—are not perfectly aligned, which may account for the modest connection between them. In addition to reaction time, two occasional correlations were found with the number of errors in the blocks of the first task and the TMT-B and phonemic fluency tests. These correlations were of very low intensity.

Although the correlations between the first computer-generated task for mental shifting/mental flexibility and traditional executive function measures are statistically significant, they are generally low. These results suggest that the task partially taps into similar cognitive processes such as flexibility, inhibition, and general cognitive ability but does not establish a

strong connection with these functions. Furthermore, the observed correlations may be partly explained by general cognitive processing, such as reaction time, rather than by the specific demands of mental flexibility or inhibition.

The second task, the Auditory-Visual Go/No-Go Task, shows a similar pattern of correlations with traditional executive function measures as observed in the previous task. Specifically, reaction time in this task was significantly correlated with both parts of the Trail Making Test, indicating a shared demand for cognitive flexibility, as well as inhibition and processing speed across tasks. A stronger correlation was found for TMT part A, which assesses basic cognitive processing, and part B, which requires more complex task switching and inhibition, reflecting the task's focus on cognitive control. Additionally, performance on the task, taking into account both reaction speed and error rate, was negatively correlated with Raven's Advanced Progressive Matrices scores, suggesting that individuals with higher general cognitive ability tend to perform faster in this task, possibly due to greater processing speed. The negative correlation with semantic fluency further supports the notion that faster reaction times in this inhibition task may reflect greater cognitive efficiency and the ability to switch between tasks or concepts. These findings suggest that inhibition capacity, measured through reaction time, is closely linked to broader cognitive abilities, including processing speed, cognitive flexibility, and general intelligence.

However, no significant correlations were found with more typical inhibition measures from classical tasks, such as those derived from the Wisconsin Card Sorting Test, including Perseverative errors, Perseverative responses, and Failure to maintain a set. This absence of significant associations suggests that while the computer-generated task taps into inhibitory control, it may do so in a slightly different way or engage different cognitive processes compared to traditional inhibition measures.

The lack of significant correlations with measures from classic tasks for assessing executive function inhibition further suggests that these may represent distinct aspects or types of inhibitory function. Research has shown that inhibitory measures derived from different methods (e.g., the Stop-Signal and Stroop tasks) exhibit low intercorrelations - a finding that has been interpreted as evidence for multiple types of inhibitory functions (Khng

& Lee, 2014). Some researchers also argue that while the ability to inhibit a predominant response is central to cognitive control, it remains an open question whether the same neural mechanisms mediate inhibition across various tasks designed to assess it (Wager et al., 2005).

This also applies to other cognitive tasks, as studies have shown that correlations between tasks designed to measure the same executive function are generally low to moderate in intensity (Miyake et al., 2000). One explanation for this is that measures of executive functions obtained from individual tasks are always contaminated by the specific characteristics of the task itself and the stimulus materials used in it.

It is also important to consider that in this task, designed for this study, as well as in other Go/NoGo tasks, there is a certain saturation effect related to working memory and mental shifting. These tasks require the engagement of working memory in order to effectively retrieve and maintain the single rule for when and on which stimuli a response should be inhibited (Luciano et al., 2001).

The correlations between reaction times in different experiments are statistically significant and moderate, while the error rates show low, positive correlations. These findings align with the expected low to moderate phenotypic correlation between mental set shifting and inhibition tasks. Both processes rely on working memory and cognitive flexibility (Diamond, 2013; Friedman & Miyake, 2004), with shifting often requiring the inhibition of previous responses. As such, individuals with better set-shifting abilities are likely to exhibit higher levels of inhibition, as both processes rely on a similar cognitive strategy. The overlap in cognitive resources is supported by the shared involvement of the prefrontal cortex (Wager et al., 2005).

The moderate reaction time correlation suggests that set shifting and inhibition share a cognitive foundation but with subtle differences in cognitive control. Weaker correlations in errors point to individual factors, such as attention or motivation, influencing task performance. Both tasks depend on working memory, highlighting cognitive flexibility as key to managing multiple tasks.

The results of our study showed that the experimental procedures involving reaction time demonstrated moderate to good reliability in most blocks, particularly in the second experiment (Auditory-Visual Go/No-Go

Task). On the other hand, the number of errors in both experiments exhibited poor reliability, suggesting greater variability in participants' responses, which made it more challenging to accurately measure errors in these tasks.

Conclusions and limitations

Validating computer-based assessments is crucial to ensure their reliability and understand their role in evaluating executive functions. The study tested the psychometric properties of these tools, demonstrating that they can complement traditional methods, offering a more comprehensive and flexible approach to understanding cognitive functioning. While the results suggest that the computer-based tasks capture important cognitive abilities such as inhibition and mental shifting, it is clear that further validation is required, particularly in terms of their generalizability across diverse populations and contexts. It will be essential to expand testing to more varied demographic groups, including individuals with neurological disorders, aging populations, and those from different cultural backgrounds, to better understand the broader applicability of these tools.

Moreover, the study highlighted the complexity of linking computer-based assessments with traditional executive function measures. While the low to moderate correlations observed between the computer-based tasks and traditional tests (such as the WCST and TMT) underscore the need for a more nuanced understanding of how different tasks assess executive function, these correlations were expected. This is because computer-based tasks and traditional measures may rely on distinct yet overlapping cognitive processes. Therefore, the predominantly low correlations observed reflect the complex relationship between tasks that share some common cognitive resources but are not fully interchangeable. These correlations are not necessarily a limitation; rather, they emphasize the multidimensional nature of executive function, suggesting that each task captures different facets of cognitive control, which may not always align perfectly.

Additionally, the findings suggest that executive functions are not isolated abilities but interrelated cognitive processes that share common neural resources, such as working memory and cognitive flexibility. This highlights the need for further research to explore the shared and unique

contributions of different cognitive processes to performance on various executive function tasks.

Future research should focus on integrating these tools into existing assessment batteries for more accurate insights into cognitive functioning. Optimizing assessments to minimize biases like screen fatigue or technology unfamiliarity is crucial. Additionally, refining task designs to reduce errors from fatigue and working memory saturation is needed. The effectiveness of these tools should be evaluated in diverse populations, including those with neurological disorders, older adults, and people with limited technology experience. Exploring how these tasks interact with other cognitive processes will enhance our understanding of executive functions, while investigating the neurobiological mechanisms could provide deeper insights into both non-clinical and clinical populations.

Given the limitations, the results should be interpreted with caution. The sample, mainly consisting of highly educated individuals, may not represent broader populations, potentially reducing variability in executive function measures. The small sample size and gender imbalance could also limit statistical power. Additionally, consecutively completing the tasks may have led to cognitive fatigue, affecting performance, particularly on tasks requiring sustained attention or inhibitory control. Technology-related biases, such as screen fatigue or unfamiliarity with digital platforms, may have further influenced results.

Another limitation is the lack of established norms for these computer-based tasks, making it difficult to interpret results across populations. Future research should address these gaps, including exploring the applicability of these tools in clinical populations and diverse cultural groups.

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Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

The data supporting the findings of this study will be made available on OSF upon publication, along with instructions for their use.

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Appendix

Appendix A

Table A1

Sociodemographic characteristics of study subjects

Age (years; *M*, *SD*)	Range (18-58) 24.06 ± 7.02
Gender (*N*; %)	
male	134 (28.63%)
female	334 (71.37%)
Education level (N; %)	
Primary education (8 years in total)	2 (0.87%)
Secondary (11-12 years in total)	59 (25.76%)
Higher School and University (16-17 years in total)	50 (21.83%)
Student	113 (49.34)%
Other	5 (2.18%)

Note. *N* - number of participants; Min - minimum age; Max - maximum age; *M* - mean age; *SD* - standard deviation of age.

Appendix B

Table B1

Twin sample description

	N	%	Min	Max	*M*	*SD*
MZ pairs	153	65.38	18	58	24.62	7.38
DZ pairs	81	34.62	18	48	23.02	6.24
MZ male pairs	37	24.18	18	58	23.69	7.41
MZ female pairs	116	75.82	18	47	24.91	7.37
SS DZ pairs	45	55.56	18	48	23.27	6.48
DS DZ pairs	36	44.44	18	41	22.72	6.00
Male participants	138	29.49	17	58	22.98	6.38
Female participants	330	70.51	16	48	24.52	7.24

Note. *N* - number of pairs/participants; *Min* - minimum age; *Max* - maximum age; *M* - mean age; *SD* - standard deviation of age; All descriptive parameters correspond to the pairs or participants specified in the first column of the table; MZ – monozygotic; DZ – dizygotic; SS – same sex; DS – different sex.

Appendix C

Table C1

Descriptive statistical parameters for all used measures

Variable	Min	Max	*M*	*SD*	Skewness	Kurtosis
Categories completed	1.50	238.00	119.36	46.29	-1.66	1.06
Perseverative errors	1.00	238.00	118.91	68.81	0.03	-1.21
Perseverative responses	1.00	238.00	118.91	68.83	0.03	-1.22
Non-perseverative errors	1.00	238.00	118.83	68.82	0.03	-1.21
Failure to maintain set	76.00	238.00	119.22	56.78	0.86	-1.05
Trials to complete the first category	1.50	238.00	119.88	65.96	0.14	-1.09
Total No. of correct answers	1.00	238.00	118.50	68.41	0.02	-1.20
Total No. of errors	1.00	238.00	118.83	68.98	0.02	-1.21
Conceptual level responses	7.81	96.00	71.95	17.13	-1.20	0.98
Categorizing efficiency	0.00	99.00	68.39	26.96	-0.99	-0.33
TMT-A reaction time	1.00	238.00	119.00	68.77	0.02	-1.20
TMT-B reaction time	1.00	238.00	119.81	68.76	-0.01	-1.20
Phonemic fluency	3.00	22.33	11.43	3.16	0.21	-0.08
Semantic fluency	10.00	44.00	24.04	5.53	0.49	0.51
Advanced Progressive Matrices	2.00	35.00	20.72	6.17	-0.44	0.05
T1 B1 RT	-2.74	2.74	0.00	1.00	0.00	-0.10
T1 B2 RT	-2.74	2.74	0.00	1.00	0.00	-0.10
T1 B3 RT	-2.74	2.74	0.00	1.00	0.00	-0.10
T1 B4 RT	-2.74	2.74	0.00	1.00	0.00	-0.10
T1 B5 RT	-2.74	2.74	0.00	1.00	0.00	-0.10

T1 B1 Er	-2.50	2.74	0.05	0.87	0.50	0.37
T1 B2 Er	-1.20	2.74	0.03	0.91	0.39	-0.41
T1 B3 Er	-0.63	2.74	0.06	0.81	0.94	-0.07
T1 B4 Er	-0.81	2.74	0.05	0.86	0.68	-0.30
T1 B5 Er	-2.25	2.74	0.04	0.87	0.50	-0.05
T2 B1 RT	-2.83	2.83	0.00	1.00	0.00	-0.08
T2 B2 RT	-2.83	2.83	0.00	1.00	0.00	-0.08
T2 B3 RT	-2.83	2.83	0.00	1.00	0.00	-0.08
T2 B1 Er	-0.75	2.83	0.05	0.85	0.76	-0.24
T2 B2 Er	-0.98	2.83	0.04	0.89	0.54	-0.41
T2 B3 Er	-1.81	2.83	0.01	0.97	0.12	-0.34

Note. The number of participants for the cognitive measures was *N* = 468; T1 = Mental Shifting/Flexibility Task (*N* = 324); T2 = Auditory-Visual Go/No-Go Task (*N* = 428); B1-B5 = block number; RT = reaction time; Er = number of errors.

Appendix D

Table D1

Correlations between RTs and the number of errors of computer-based tasks

	T2 B1 RT	T2 B2 RT	T2 B3 RT	T2 B1 Er	T2 B2 Er	T2 B3 Er
T1 B1 RT	.306**	.288**	.312**	-.072	-.075	-.041
T1 B2 RT	.414**	.324**	.311**	-.124*	-.115*	.118*
T1 B3 RT	.454**	.445**	.359**	-.122*	-.171**	.017
T1 B4 RT	.473**	.412**	.389**	-.188**	-.091	-.026
T1 B5 RT	.450**	.383**	.391**	-.158**	-.070	-.002
T1 B6 RT	.460**	.397**	.318**	-.187**	-.118*	.024
T1 B1 Er	.126*	.035	.111*	.015	.114*	.109
T1 B2 Er	-.096	-.064	-.075	.139*	.028	.088
T1 B3 Er	-.173**	-.104	-.100	.152**	.159**	.042
T1 B4 Er	-.135*	-.127*	.083	.134*	.169**	.142*
T1 B5 Er	-.175**	-.184**	-.107	.151**	.175**	.029
T1 B6 Er	-.066	-.071	.033	.032	.104	.182**

Note. T1 = Mental Shifting/Flexibility Task (*N* = 324); T2 = Auditory-Visual Go/No-Go Task (*N* = 428); B1-B5 = block number; RT = reaction time; Er = number of errors.

Appendix E

Table E1

Correlations between reaction times (RTs) and the number of errors in the same computer-based task (Mental Shifting/Flexibility Task)

	E1 B1 Er	E1 B2 Er	E1 B3 Er	E1 B4 Er	E1 B5 Er
E1 B1 RT	.215**	-.244**	.004	-.210**	-.094
E1 B2 RT	.085	-.089	-.020	-.178**	-.081
E1 B3 RT	-.087	-.231**	-.124*	-.293**	-.178**
E1 B4 RT	-.022	-.149**	-.013	-.208**	-.169**
E1 B5 RT	-.042	-.143**	-.035	-.250**	-.144**

Note. B1-B5 = block number; RT = reaction time; Er = number of errors.

Appendix F

Table F1

Correlations between reaction times (RTs) and the number of errors in the same computer-based task (Auditory-Visual Go/No-Go Task)

	E2 B1 Er	E2 B2 Er	E2 B3 Er
E2 B1 RT	-.249**	-.122*	.003
E2 B2 RT	-.232**	-.301**	-.070
E2 B3 RT	-.149**	.050	.003

Note. B1-B3 = block number; RT = reaction time; Er = number of errors.

Appendix G

Table G1

Intraclass correlation coefficients (ICC) for used measures

Variable	ICC	*p* value	Evaluation of the reliability
Categories completed	0.330	0.001	Poor
Perseverative errors	0.276	0.007	Poor
Perseverative responses	0.278	0.007	Poor
Non-perseverative errors	0.254	0.013	Poor
Failure to maintain set	0.099	0.214	Poor
Trials to complete the first category	0.202	0.042	Poor
Total No. of correct answers	0.084	0.251	Poor
Total No. of errors	0.256	0.012	Poor
Conceptual level responses	0.247	0.016	Poor
Categorizing efficiency	0.289	0.005	Poor
TMT-A reaction time	0.533	0.000	Moderate
TMT-B reaction time	0.483	0.000	Moderate
Phonemic fluency	0.596	0.000	Good
Semantic fluency	0.543	0.000	Moderate
Advanced Progressive Matrices	0.772	0.000	Excellent
T1 B1 RT	0.584	0.000	Moderate
T1 B2 RT	0.603	0.000	Good
T1 B3 RT	0.574	0.000	Moderate
T1 B4 RT	0.652	0.000	Good
T1 B5 RT	0.682	0.000	Good
T1 B1 Er	0.380	0.001	Poor
T1 B2 Er	-0.005	0.513	Poor

T1 B3 Er	0.160	0.134	Poor
T1 B4 Er	0.525	0.000	Moderate
T1 B5 Er	0.080	0.297	Poor
T2 B1 RT	0.639	0.000	Good
T2 B2 RT	0.511	0.000	Moderate
T2 B3 RT	0.581	0.000	Moderate
T2 B1 Er	0.249	0.019	Poor
T2 B2 Er	0.359	0.001	Poor
T2 B3 Er	0.314	0.003	Poor

Note. T1 = Mental Shifting/Flexibility Task (*N* = 324); T2 = Auditory-Visual Go/No-Go Task (*N* = 428); B1-B5 = block number; RT = reaction time; Er = number of errors; ICC values were interpreted as follows (Cicchetti, 1994): values below 0.40 indicate poor reliability, values between 0.40 and 0.59 indicate moderate reliability, values between 0.60 and 0.74 indicate good reliability, and values of 0.75 or higher indicate excellent reliability.