



University of Zagreb

Faculty of Education and Rehabilitation Sciences

Filipa Čavar Mišković

**MINDFULNESS IN THE PROMOTION OF
ADOLESCENTS' MENTAL HEALTH
– INTERRELATION WITH
STRESS AND ANXIETY**

DOCTORAL DISSERTATION

Zagreb, 2026



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Mentors:

Professor Goran Milas, Ph.D.

Professor Josipa Mihić, Ph.D.

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Edukacijsko-rehabilitacijski fakultet

Filipa Ćavar Mišković

**USREDOČENA SVJESNOST U
PROMOCIJI MENTALNOG ZDRAVLJA
ADOLESCENATA
– MEĐUODNOS SA
STRESOM I ANKSIOZNOSTI**

DOKTORSKI RAD

Mentori:

Prof.dr.sc. Goran Milas

Prof.dr.sc. Josipa Mihić

Zagreb, 2026.

ABOUT THE SUPERVISORS

Prof. Goran Milas, PhD

Goran Milas (born 1963 in Mumbai, India) is a psychologist by training, a Senior Research Advisor, and an adjunct Full Professor at the Institute of Social Sciences Ivo Pilar, where he has been continuously employed since 1992.

He has extensive research and teaching experience, with an academic career spanning since 1989. He has taught numerous courses—primarily in research methodology—at undergraduate, graduate, and doctoral levels across several higher education institutions, including the Faculty of Croatian Studies, the Catholic University of Croatia, the Faculty of Education and Rehabilitation Sciences, the Study Centre of Social Work, and VERN' University of Applied Sciences.

Over the course of his career, he has participated as principal investigator or collaborator in more than 30 scientific research projects funded by the Croatian Science Foundation, the European Commission, the European Social Fund, the Ministry of Science and Education, and other institutions.

Although primarily a specialist in research methodology, in the past five years he has contributed to a broad range of interdisciplinary social science projects addressing youth stress and coping, cultural heritage and identity, quality of life among Croatian war veterans, and reproductive and sexual health among young people. During this period, he also served as principal investigator on two projects focused on adolescent stress: *Longitudinal Adolescent Stress Study* and *Daily Stress in Late Adolescence and Emerging Adulthood*.

He is the author of four scholarly books and around eighty scientific articles, mostly published in leading international journals. In 2006, he received the Annual State Award for Science in the field of social sciences.

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Prof. Josipa Mihić, PhD

Prof. Josipa Mihić is a Full Professor at the Department of Behavioral Disorders, Faculty of Education and Rehabilitation Sciences, University of Zagreb. She graduated in Social Pedagogy from the same Faculty and has been employed there since 2008, initially as a research assistant at the Department of Behavioral Disorders. In the same year, she enrolled in the postgraduate doctoral program *Prevention Science and Disability Studies* at the Faculty of Education and Rehabilitation Sciences, where she obtained her PhD in 2013. She is a member of the Laboratory for Prevention Research. Together with her colleagues, she received the international European award for achievements in prevention science, the *Sloboda Medal Award*, granted by the European Society for Prevention Research in 2018. The Laboratory was also awarded in 2022 by the Society for Prevention Research for its contribution to prevention science in the area of international collaboration. She has presented her work at more than 90 scientific and professional conferences, both international and national, and has delivered several invited lectures. She has published 32 scientific articles and 9 chapters in scientific books. She is involved in teaching courses in the field of prevention science at the undergraduate and graduate levels of the Social Pedagogy program, as well as at the doctoral program in Prevention Science. She also teaches in the postgraduate specialist program in Early Intervention at the Faculty of Education and Rehabilitation Sciences, University of Zagreb, and in the specialist program on Children's Rights at the Faculty of Law, University of Zagreb. Additionally, she teaches in a postgraduate specialist program at the Faculty of Education, University of Maribor. She has supervised or co-supervised 45 master's theses and 7 doctoral dissertations in the field of prevention science. She has participated in numerous international and national research and professional projects, including competitive projects in prevention science. Her research interests include school-based prevention, risk behaviors, social-emotional learning, and the effects of contemplative practices, including mindfulness on children and youth. In 2019, she completed a research stay at the Social Development Research Group, University of Washington, Seattle, USA. From 2023 to 2025, she served as the Head of the undergraduate and graduate Social Pedagogy programs, and from 2021 to 2024 she was the Head of the Department of Behavioral Disorders. From 2022 to 2024, she was a member of the editorial board of the journal *Croatian Review of Rehabilitation Research*. She is a member of several national and international scientific and professional associations, including the Contemplative Education Network (co-founder), Mind and Life Europe, the Croatian

Association of Social Pedagogues, the European Society for Prevention Research (EUSPR), and the Society for Prevention Research (SPR). She is also a licensed Gestalt psychotherapist.

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"The soul becomes dyed with the color of its thoughts.

If you are distressed by anything external, the pain is not due to the thing itself, but to your estimate of it; and this you have the power to revoke at any moment.

You have power over your mind – not outside events. Realize this, and you will find strength"

- Marcus Aurelius, *Meditations*

Zahvale

Ovo istraživanje ne bi bilo moguće bez svih koji su u njemu sudjelovali. Hvala studentima koji su pomogli u prikupljanju podataka na terenu, a posebno Matei na doprinosu u provedbi programa. Posebno važna zahvala ide i svim učenicima koji su sudjelovali u istraživanju, a osobito onima koji su sudjelovali u *mindfulness* programu – bez njihovog sudjelovanja, ovo istraživanje ostalo bi samo ideja.

Posebno hvala psihologinjama Mariji i Ani, te ravnateljima IV. i XVI. gimnazije u Zagrebu, koji su otvorili svoja vrata drugom dijelu ovog istraživanja. Vaša spremnost i otvorenost omogućili su provedbu programa u školskom okruženju, te je u vašim školama moja ideja dobila priliku postati nešto stvarno.

Istraživanja pokazuju da iza svakog uspješnog doktorata stoji dobar mentor i da ta veza, posebno u području mentalnog zdravlja, znači više nego što se na prvi pogled čini. Ova disertacija, u obliku u kojem jest, ne bi nastala bez vođenja i podrške mojih mentora.

Osobito hvala prof. Goranu Milasu na svojoj podršci i vođenju na ovom doktorskom putovanju. Osim što je *STRESS LOAD* projekt bio temelj ove disertacije, upravo je Goranov poticaj doveo do intervencijskog dijela istraživanja – na čemu sam danas neizmjerljivo zahvalna. Kroz četiri i pol godine znali ste pronaći pravu mjeru između podrške i izazova, uvijek praćene toplinom i razumijevanjem u najizazovnijim trenucima. Hvala što ste me naučili da se u znanosti, kao i u životu, daleko više postiže strpljenjem i mudrošću – a to je puno više od samo lekcije iz metodologije. Hvala vam na prilici koja je nekada bila veliki san, povjerenju i znanjima koja su oblikovala ne samo moj profesionalni, već i osobni razvoj.

Mojoj mentorici, prof. Josipi Mihić, hvala što je u ovaj proces donijela nešto što se rijetko nailazi – blagost i optimizam koji su me pronalazili upravo kada su bili najpotrebniji. Svim budućim doktorandima želim mentoricu koja će im pogurati vjeru u vlastiti rad onda kada im

je to najpotrebnije. Hvala vam na poučavanju upravo onih *mindfulness* vještina koje sam istraživala.

Ovo putovanje ne bi bilo moguće bez svih prijašnjih mentorstava koja su me oblikovala na obrazovnom i profesionalnom putu. Stoga, hvala svim mojim mentorima koji su oblikovali psihologinju i znanstvenicu kakva danas jesam. Osobito sam zahvalna na onim rijetkim mentorstvima koja su prerasla u velika prijateljstva.

Veliko hvala i mojim prijateljima koji su me bodrili na ovom često usamljenom putovanju. Osobito hvala Sari koja je uvijek bila moje sigurno mjesto za sve nesigurnosti i zapinjanja. Hvala za sve razgovore i ohrabrenja u pravom trenutku!

Mojoj obitelji, roditeljima i sestri – hvala na bezuvjetnoj podršci koja me nosila kroz sve ove godine. Hvala i mojoj baki, koja uvijek prvo i najvažnije pita „Kako si?“, jer, ipak, mentalno zdravlje nije samo usputna tema. Hvala vam što me držite za ruku na svim životnim putovanjima!

I na kraju, ali nipošto na posljednjem mjestu – hvala mom suprugu. Hvala što si uvijek vjerovao u mene i znao me pogurati da izađem iz svog opreza i sigurne zone. Hvala ti što sa mnom sanjaš i koračaš na ovom zajedničkom životnom putovanju. Teško je ostati *mindful* uz 6900 kilometara udaljenosti i šest sati vremenske razlike, no uz tebe je i nošenje sa stresom lakše unatoč oceanu koji nas u zadnje vrijeme dijeli. Hvala ti što me podsjećaš koliko je istovremeno izazovno i jednostavno ostati u trenutku. Boja mojih misli je šarenija uz tebe!

Ova mala neobična zahvala ide i jednom ne tako malom psu. Osim što je bio moja emocionalna podrška i budno popratio svu znanstvenu produkciju, naučio me je kako je, ako si dovoljno prisutan, svaka šetnja jedno novo iskustvo i prilika za mentalni reset.

Summary

This dissertation examined the interrelationships between mindfulness, stress, and anxiety in Croatian adolescents, combining a longitudinal study with a quasi-experimental effectiveness study of a school-based mindfulness program. The research was considered within the broader context of rising prevalence of adolescent anxiety (Racine et al., 2021; Solmi et al., 2022) and the limited availability of evidence-based preventive strategies for adolescent population in Croatia.

Study 1 tested an empirical model integrating the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) with the stress sensitization model (Stroud, 2020), positioning mindfulness in a dual role within the stress-anxiety pathway. The proposed moderated mediation model was supported based on the two-wave longitudinal data from Croatian adolescents. Objective stress predicted later anxiety both directly and indirectly through subjective stress, consistent with stress sensitization pathway. Trait mindfulness moderated the translation of stressful life events into subjective stress, supporting the mindfulness stress buffering account (Creswell & Lindsay, 2014). Mindfulness also predicted lower later anxiety, both directly and indirectly through reduced subjective stress, consistent with the Mindfulness-to-Meaning Theory (Garland et al., 2015b). These findings position mindfulness as a single metacognitive capacity operating at multiple points in the stress process, as a buffer at the appraisal stage, and as a protective factor at the level of anxious cognitions.

Study 2 evaluated the preliminary effectiveness of the Learning to BREATHE program (Broderick, 2013), adapted for delivery in Croatian secondary schools. Contrary to expectations, the intervention did not produce reliable improvements in trait mindfulness, subjective stress, or mental well-being. Anxiety symptoms and frequency of automatic thoughts were higher in the intervention group at post-intervention. These findings are consistent with recent large-scale evidence on universal school-based mindfulness interventions (Dunning et al., 2022; Kuyken et al., 2022) and were constrained by the dosage limitations, the developmental fit of universal delivery, and student engagement.

Together, the two studies contribute to adolescent mental health research by establishing how trait mindfulness operates in the stress–anxiety pathway, by demonstrating the conceptual and empirical importance of distinguishing objective and subjective stress (Slavich, 2016), and by providing the first quasi-experimental evaluation of a mindfulness-based program in Croatian high-school adolescents. The findings argue for preventive actions that target the

processes linking stress to anxiety and indicate that brief universal mindfulness programs are unlikely to be sufficient as standalone strategies for the prevention of adolescent mental health problems.

Key words: mindfulness, stress, anxiety, adolescents, mental health

Sažetak

Uvod

Adolescencija predstavlja ranjiv period za razvoj problema mentalnog zdravlja, obzirom na nagle razvojne, biološke, emocionalne i socijalne promjene (Arnett, 1999). Problemi mentalnog zdravlja prisutni tijekom adolescencije, povezani su sa kasnijim razvojem (mal)adaptivnih vještina suočavanja, kao i tijekom mentalnog zdravlja u kasnijoj odrasloj dobi (Milas i sur., 2023) i sveopćom dobrobiti (Samji i sur., 2022). Stoga je porast prevalencije anksioznih simptoma kod adolescenata sve je više istaknut kao jedan od glavnih javnozdravstvenih problema mentalnog zdravlja. Recentne meta-analize ističu kako je vidljiv porast prevalencije simptoma anksioznosti kod adolescenata na globalnoj razini (Racine i sur., 2021), pri čemu jedna trećina svih problema mentalnog zdravlja nastaje prije 14. godine (Solmi i sur., 2022). Svjetska zdravstvena organizacija (2024) ističe kako se svaki sedmi adolescent u dobi između 10 i 19 godina suočava sa problemima mentalnog zdravlja koji često ostaju neadresirani. Podaci istraživanja na hrvatskim adolescentima (Milas i sur., 2025b) pokazuju kako 11 do 20% djevojaka i 3 do 6% mladića u srednjoškolske dobi pokazuje klinički značajne simptome anksioznosti, što potvrđuje ozbiljnost ovoga problema na nacionalnoj razini.

Razumijevanje anksioznosti važno je razmatrati u okviru stresa i relevantnih procesa koji doprinose mentalnom zdravlju. Stoga je ovo istraživanje obuhvatilo tri teorijska okvira koja su integrirana u jedan procesni model stresa i anksioznosti kod adolescenata. Transakcijski model stresa i suočavanja (Lazarus i Folkman, 1984) obuhvaćen je kao temelj za razlikovanje objektivnih stresora od subjektivne procjene stresa, te čini primarni procesni put u odnosu stresa i anksioznosti predloženog modela. Ovom modelu pridodan je model senzitivizacije na stres (Stroud, 2020) koji objašnjava kako prethodna izloženost stresu mijenja prag pri kojem novi stresori izazivaju psihološki odgovor, te doprinose razvoju anksioznosti. Stoga je stres razmatran iz perspektive izloženosti objektivnim stresorima i subjektivnog ili psihološkog stresa, sukladno suvremenim istraživanjima u ovom području, a koja ističu važnost metodološkog razlikovanja ova dva aspekta stresa (Slavich, 2016). Konačno, konstrukt osobine usredotočene svjesnosti (*trait mindfulness*) obuhvaćen je u ovom procesnom modelu kao zaštitni čimbenik mentalnog zdravlja. Usredotočena svjesnost odnosi se na pridavanje i usmjeravanje pažnje aspektima situacije u danom trenutku, uključujući tjelesne osjete, misli i emocije, pri čemu se događajima pristupa otvorenim, ne osuđujućim stavom (Kabat-Zinn, 2003). Usredotočena svjesnost integrirana je u procesni model stresa i anksioznosti, kao

čimbenik koji deautomatizira ranije naučene kognitivne obrasce reaktivnosti na stres. Sukladno relevantnim teorijama (Mindfulness-to-Meaning Theory; Garland i sur., 2015b) i hipotezi mindfulnessa kao zaštitnog faktora u stresu (Creswell i Lindsay, 2014), pretpostavljena je dualna uloga ovog konstrukta unutar stresnog procesa. Time je usredotočena svjesnost prvi put uključena kao dvojni zaštitni čimbenik u odnosu objektivnih stresora, subjektivnog stresa na kasniju anksioznost kod adolescenata. Moderirajuća uloga usredotočene svjesnosti pretpostavljena je u mehanizmu senzitivacije na stres, dok je zaštitna uloga usredotočene svjesnosti ispitana u odnosu subjektivne procjene stresa i kasnijih simptoma anksioznosti.

Konačno, ovo istraživanje obuhvaća dvije komplementarne studije. U prvoj studiji ispitani su procesni odnosi obuhvaćenih varijabli mentalnog zdravlja, dok je druga studija obuhvatila translacijski aspekt istraživanja te nastojala utvrditi učinak preventivnog programa zasnovanog za usredotočenoj svjesnosti na mentalno zdravlje adolescenata.

Istraživački cilj i problemi

Ova doktorsko istraživanje imalo je za cilj istražiti odnos između izloženosti objektivnim stresorima i psihološkog ili subjektivnog stresa, usredotočene svjesnosti i anksioznosti među adolescentima te ispitati učinak intervencije temeljene na svjesnosti na percepciju stresa i mentalnog zdravlja adolescenata. Kako bi se postigao ovaj istraživački cilj, predložena su tri specifična istraživačka problema i povezane hipoteze. Prvi istraživački problem odnosio se na utvrđivanje međuodnosa usredotočene svjesnosti, psihološkog stresa i anksioznosti kod adolescenata. Drugi istraživački problem odnosio se na empirijsku provjeru pretpostavljenog modela međuodnosa stresa, usredotočene svjesnosti i anksioznosti kod adolescenata. Konačno, treći istraživački problem odnosio se na procjenu učinka intervencije temeljene na usredotočenoj svjesnosti (*mindfulness-based program*) na percepciju stresa i mentalno zdravlje adolescenata.

Metoda

U istraživanju su sudjelovali učenici srednjih škola s područja Grada Zagreba. Studija 1 je dio šireg projekta Hrvatske zaklade za znanost *Longitudinalno istraživanje stresa kod adolescenata* (Institut Ivo Pilar). Ovom studijom obuhvaćeno je 1084 učenika prvih i drugih razreda iz 17 srednjih škola, prosječne dobi 15.9 godina, koji su sudjelovali u dva istraživačka vala. U Studiji 2, odabrane su dvije škole identičnih karakteristika od prethodno uključenih škola u šire istraživanje, a koje su pokazale spremnost na sudjelovanje u evaluaciji programa.

Stoga je u Studiji 2 sudjelovalo 237 učenika koji su ovisno o pripadnosti školi bili raspoređeni u kontrolnu ili intervencijsku skupinu. Svi učenici sudjelovali su u tri toče mjerenja: prije, neposredno nakon i 3 mjeseca nakon završene provedbe programa. Samo učenici intervencijske skupine sudjelovali su u programu koji je uključivao šest *mindfulness* treninga unutar redovne nastave.

Rezultati

Studija 1

Studija 1 obuhvaća longitudinalnu studiju s dvije točke mjerenja koja je testirala model moderirane medijacije i obuhvaća prva dva istraživačka problema. Postavljena je hipoteza da stresni životni događaji predviđaju kasniju anksioznost izravno i posredno kroz subjektivni stres, te da usredotočena svjesnost djeluje dvojako, kao moderator odnosa između objektivnih stresora i subjektivnog stresa (odnosno na putu senzitivacije na stres), te kao zaštitni faktor s izravnim i posrednim učinkom na kasniju anksioznost (odnosno kao čimbenik koji ublažava subjektivnu procjenu stresa i izravno smanjuje anksioznost). Rezultati su potvrdili postavljene hipoteze te je testirani model je u potpunosti podržan podacima. Stresni životni događaji značajno su pozitivno predviđali kasniju anksioznost, kako izravno tako i posredno preko subjektivnog stresa, što je u skladu s modelom senzitivacije na stres (Stroud, 2020). Usredotočena svjesnost je značajno je moderirala odnos između objektivnih stresora i subjektivnog stresa, te se visokim razinama usredotočene svjesnosti, izloženost stresnim događajima više se nije značajno doprinosila subjektivnom stresu (Creswell i Lindsay, 2014). Također, usredotočena svjesnost je značajno negativno predviđala kasniju anksioznost, kako izravno tako i neizravno putem nižeg subjektivnog stresa. Rezultati Studije 1 stoga potvrđuju dualnu ulogu usredotočene svjesnosti, koja kao jedinstvenu metakognitivna vještina koja djeluje na više točaka unutar procesa stresa i anksioznosti: kao *buffer* i moderator u fazi procjene stresora, te kao zaštitni čimbenik na razini anksioznih simptoma (Garland i sur., 2015b).

Studija 2

Studija 2 je kvazi-eksperimentalna studija koja je za cilj imala evaluaciju preliminarnu učinkovitosti programa Learning to BREATHE (Broderick, 2013), prilagođenog za hrvatski srednjoškolski kontekst. Učinkovitost je procjenjivana na razini usredotočene svjesnosti, subjektivnog stresa, simptoma anksioznosti, mentalne dobrobiti te učestalosti i uvjerenja u automatske misli. Suprotno očekivanjima, program nije pokazao značajna poboljšanja na razini

ispitivanih ishoda. Štoviše, anksiozni simptomi i frekvencija automatskih misli bili su viši kod adolescenata iz intervencijske skupine pri post-intervencijskoj procjeni, dok je razina mentalne dobrobiti bila viša u kontrolnoj skupini. Pri praćenju nakon tri mjeseca nisu utvrđene značajne razlike između skupina. Ovi nalazi u skladu su s rezultatima recentnih istraživanja velikih međunarodnih studija, uključujući MYRIAD studiju (Kuyken i sur., 2022) i druge meta-analize koje upućuju na ograničene učinke univerzalnih školskih intervencija zasnovanih na usredotočenoj svjesnosti (Dunning i sur., 2022; Galla i sur., 2024).

Dobivene rezultate Studije 2 svakako je važno razmotriti iz više perspektiva. Naime, nepotvrđena učinkovitost ovog konkretnog programa koji je zasnovan na vještinama socio-emocionalnog učenja i *mindfulness* treningu, a ne predstavlja „čisti“ *mindfulness* program (pr. MBCT ili MBSR), ne umanjuje važnost promocije mentalnog zdravlja i razvoja sličnih *mindfulness* vještina i vještina socio-emocionalnog učenja i suočavanja sa stresom. Naime, više razine anksioznosti kod adolescenata u intervencijskoj skupini ne znači nužno da je *mindfulness* trening povećao anksioznost, već ovaj rezultat može odražavati prijelazno razdoblje u kojem je intrapersonalna svjesnost porasla prije nego što se razvio kapacitet za emocionalnu regulaciju. Također, *mindfulness* vještine doprinose adaptivnijem prepoznavanju kognitivnih obrazaca koji su uobičajeno habitualni i automatski. Viša frekvencija automatskih misli stoga može reflektirati pomak u metakognitivnom procesiranju, pri čemu adolescenti postaju svjesniji misli koje su prethodno bile obrađivane na automatskoj razini. Ograničena učinkovitost programa interpretirana je kroz prizmu implementacijskih čimbenika u vidu trajanja programa, primjerenosti univerzalnog programa, te angažmana učenika u osobnoj *mindfulness* praksi (Roeser i sur., 2022).

Zaključak

Rezultati ovog istraživanja upućuju da *mindfulness* oblikuje subjektivnu procjenu stresa i djeluje kao zaštitni mehanizam za mentalno zdravlje smanjujući posljedice stresa. Teorijski doprinos ove disertacije ističu se u integraciji usredotočene svjesnosti s teorijama stresa unutar jednog jedinstvenog procesnog modela, kao i u empirijskoj potvrdi dualne uloge usredotočene svjesnosti u procesu stresa u adolescenciji. Međutim, putevi potvrđeni empirijskim modelom, nisu reproducirani u studiji učinkovitosti *mindfulness* programa. Umjesto toga, rezultati učinaka programa na mentalno zdravlje adolescenata, radije pružaju smjernice za buduće studije učinkovitosti i implementacije *mindfulness* programa u školskom kontekstu. Konačno, rezultati ovog istraživanja ističu važnost sveobuhvatne i nacionalno široke procjene mentalnog zdravlja

adolescenata koja je potrebna kako bi se pružili razvojno pravovremene i primjerene promotivne i preventivne akcije usmjerene mentalnom zdravlju mladih u Hrvatskoj.

Ključne riječi: usredotočena svjesnost, stress, anksioznost, mentalno zdravlje, adolescenti

CONTENTS

1. INTRODUCTION.....	1
1.1. Adolescent mental health	2
<i>1.1.1. Prevalence, incidence and global trends of adolescent anxiety</i>	<i>4</i>
<i>1.1.2. Anxiety among Croatian adolescents.....</i>	<i>5</i>
<i>1.1.3. Etiological models of anxiety.....</i>	<i>6</i>
<i>1.1.4. Adolescent vulnerability.....</i>	<i>12</i>
1.2. Stress	14
<i>1.2.1. Conceptualizing stress: Objective stress exposure and subjective stress</i>	<i>15</i>
<i>1.2.2. Transactional Model of Stress and Coping</i>	<i>17</i>
<i>1.2.3. Stress sensitization model</i>	<i>19</i>
1.3. Mindfulness	21
<i>1.3.1. Mindfulness construct</i>	<i>21</i>
<i>1.3.2. Mindfulness and mental health</i>	<i>23</i>
<i>1.3.3. Mindfulness-based interventions for adolescents</i>	<i>24</i>
<i>1.3.4. Integrating mindfulness to stress-anxiety pathways</i>	<i>28</i>
1.4. Theoretical and empirical rationale of present research	31
<i>1.4.1. Rationale for Study 1.....</i>	<i>32</i>
<i>1.4.2. Rationale for Study 2.....</i>	<i>34</i>
2. RESEARCH AIM, PROBLEMS & HYPOTHESES.....	36
3. METHODS	38
3.1. STUDY 1. Longitudinal study	39
<i>3.1.1. Design and procedure.....</i>	<i>39</i>
<i>3.1.2. Participants.....</i>	<i>39</i>
<i>3.1.3. Ethical considerations</i>	<i>40</i>
STUDY 2. Quasi-experimental effectiveness study	41
<i>3.2.1. Design and procedure.....</i>	<i>41</i>

3.2.2. <i>Participants</i>	42
3.2.3. <i>Intervention and Control conditions</i>	45
3.2.4. <i>Ethical considerations</i>	46
3.4. Measures	48
3.4.1. <i>General and sociodemographic data questionnaire</i>	49
3.4.2. <i>Mindfulness</i>	49
3.4.3. <i>Subjective (or psychological) stress</i>	50
3.4.4. <i>Objective stress (stressful life events as stressor exposure)</i>	51
3.4.5. <i>Anxiety severity</i>	52
3.4.6. <i>Mental Well-being</i>	52
3.4.7. <i>Automatic thoughts - frequency and belief</i>	52
3.5. Analytic strategy	54
3.5.1. <i>Analyses related to the Research problem 1</i>	54
3.5.2. <i>Analyses related to the Research problem 2</i>	54
3.5.3. <i>Analyses related to the Research problem 3</i>	57
4. RESULTS	59
4.1. Longitudinal study: Descriptive statistics	59
4.2. Research problem 1: Interrelationships between mindfulness, psychological stress, and anxiety	61
4.3. Research problem 2: Empirical testing of the proposed model of interrelationships among stress, mindfulness, and anxiety in adolescents	63
4.4. Study 2: Descriptive statistics	68
4.5. Descriptive levels of dependent variables by group and time point	70
4.5.1. <i>Mindfulness scores by group and time point</i>	71
4.5.2. <i>Subjective stress scores by group and time point</i>	72
4.5.3. <i>Anxiety scores by group and time point</i>	73
4.5.4. <i>Mental well-being scores by group and time point</i>	74
4.5.5. <i>Belief in automatic thoughts by group and time point</i>	75

4.5.6. <i>Frequency of automatic thoughts by group and time point</i>	76
4.6. Research problem 3: Evaluating the effect of mindfulness-based intervention on the perception of stress and adolescent mental health	77
5. DISCUSSION	83
5.1. Research problem 1: Interrelationships between mindfulness, psychological stress, and anxiety	83
5.2. Research problem 2: Empirical testing of the moderated-mediation model of interrelationships among stress, mindfulness, and anxiety in adolescents	85
5.2.1. <i>Stress sensitization and stress appraisal pathways</i>	85
5.2.2. <i>Dual role of mindfulness</i>	86
5.3. Research problem 3: Evaluating the effect of mindfulness-based intervention on the perception of stress and adolescent mental health	89
5.3.1. <i>Effects on mindfulness trait and subjective stress</i>	89
5.3.2. <i>Effects on anxiety</i>	92
5.3.3. <i>Effects on frequency and belief in automatic thoughts</i>	93
5.3.4. <i>Consistency of findings with recent evidence on MBIs effectiveness</i>	94
5.3.5. <i>Importance of implementation factors for effectiveness findings</i>	96
6. HYPOTHESES VERIFICATION	98
7. LIMITATIONS AND FUTURE DIRECTIONS	101
7.1. Limitations of STUDY 1. Longitudinal study	101
7.2. Limitations of STUDY 2. Quasi-experimental effectiveness study	103
8. CONTRIBUTIONS	106
8.1. Theoretical contributions	106
8.2. Methodological contributions	107
8.3. Empirical contributions	109
8.4. Scientific contributions to prevention science	110
9. IMPLICATIONS FOR MENTAL HEALTH PROMOTION AND PREVENTIVE ACTIONS	112

10. CONCLUSION	115
11. LITERATURE	117
12. APPENDIX	137
13. BIOGRAPHY	147

1. INTRODUCTION

Adolescent mental health is gaining central focus in mental health research and the prevention field, ever since the pandemic shed light on poor prevalence trends (Solmi et al., 2022). Anxiety symptoms are consistently shown to be one of the most prevalent mental health problems among adolescent population, with meta-analyses suggesting that global prevalence is rising (Racine et al., 2021; Shorey et al., 2022). Therefore, understanding mechanisms that contribute to the onset of anxiety in adolescence, and identifying factors that contribute to its maintenance, provides valuable information for both research and preventive practice. This dissertation aims to contribute to the prevention of mental health problems and mental health promotion in adolescents by examining the interrelationships between three key constructs – stress, mindfulness, and anxiety. Although stress and anxiety have been broadly researched, the present research provides a more integrative framework on psychology, contemplative science, and prevention science, in which these two constructs are considered from a process perspective, rather than merely mental health outcomes.

By integrating dual conceptualizations of stress, stress sensitization (Stroud, 2020) and Transactional Model of Stress and Coping (Lazarus & Folkman, 1984), the contributing role of specific stress pathways to later anxiety is examined. This specific role of stress is especially relevant considering the onset of anxiety symptoms during adolescence, and the possible negative effects that early life psychopathology has on later mental health and well-being. Therefore, alongside examining the negative pathways of stress, this research examines the dual protective role of mindfulness (Kabat-Zinn, 1994). Mindfulness has been integrated into this stress-anxiety pathway, both as a buffer in the sensitization process, and as a possible protective factor against adolescent anxiety, and one that directly shapes stress appraisal (Creswell & Lindsay, 2014; Garland, 2007; Garland et al., 2009, 2011, 2015b)

Finally, the applied preventive aspect of this dissertation is focused on assessing the preliminary effectiveness of a mindfulness-based intervention, delivered within the school setting. This second part of the research complements the proposed empirical model but aims to provide a more prevention-focused perspective on adolescent mental health. Accordingly, effectiveness was examined not only in terms of symptom outcomes but also in relation to the underlying maladaptive cognitions that contribute to maintenance of anxiety. Finally, the program effectiveness has been considered from the perspective of the dual continuum model of mental health (Keyes, 2002), with mindfulness effects have been examined on adolescent

mental well-being as well. This research aims to provide a broader understanding of adolescent mental health promotion, that simultaneously addresses risk and protective factors and cultivates individual resources for coping and flourishing.

1.1. Adolescent mental health

The increasing prevalence of mental health problems among children and adolescents has become a prominent public health concern (Racine et al., 2021; Solmi et al., 2022), and adolescence has been recognized as a vulnerable developmental period for the onset of mental health problems (Arnett, 1999). The rise of internalizing problems in adolescence is not only a developmental issue but also has prominent effects on mortality (Walker et al., 2015), later mental health trajectories and shapes future well-being (Samji et al., 2022). Thus, early identification of adolescents at risk for developing mental health problems is especially important.

A meta-analysis of 192 epidemiological studies (Solmi et al., 2022) shows that 34.6%, or one third, of all mental health problems emerge before the age of 14. Almost half of all mental health problems (48.4%) already emerged before the age of 18, and 62.5% are already present at the age of 25. As if such results were not concerning enough, Solmi et al. (2022) note that the average age of onset of mental health problems is 14.5 years. In most cultures, this marks the end of primary education and transition to secondary school.

The World Health Organization (2024) suggests that one in seven adolescents (or 14.3%) aged between 10 and 19, report impaired mental health that often remains untreated. Likewise, Kieling et al. (2024) indicate that 13.96% of older adolescents live with a mental health disorder that significantly affects their everyday functioning. Prevalence of internalizing problems has increased significantly for both anxiety and depressive symptomatology. Racine et al. (2021) estimate that the prevalence of clinically elevated symptoms is 20% for anxiety, and 25% for depressive symptoms, suggesting that one in five adolescents show clinically significant symptoms of anxiety, and about one in four adolescents report clinically significant depressive mood. While some might argue that the COVID-19 pandemic has further intensified these trajectories, others suggest that the pandemic has only shed light on an already concerning, and rather overlooked issue, by exposing trends of poor adolescent mental health (Samji et al., 2022).

Paus et al. (2008) argued that the heightened vulnerability to mental health problems in adolescence is a consequence of neurodevelopmental changes and uneven maturation of prefrontal cortex and limbic system. While adolescent vulnerability will be discussed in detail in the following chapters, it is important to note that this developmental period in a sense poses as a risk factor in itself.

Among all mental health conditions, anxiety is of particular preventive interest. Although anxiety disorders are among the first internalizing problems to onset during childhood and early adolescence (Solmi et al., 2022), these difficulties often remain untreated due to their relatively unrecognized manifestations. Thus, anxious children often go unnoticed and are usually labelled as shy. Longitudinal studies show that untreated anxiety problems in adolescence, translate into more serious anxiety disorders later in life, and are often comorbid with depressive symptoms and functional impairment (Copeland et al., 2014). However, studies show that school-based interventions have potential in reducing severity of anxiety symptoms (Werner-Seidler et al., 2021). Although, effect sizes of universal interventions remain small (Zhang et al., 2023; Werner-Seidler et al., 2021), researchers argue that anxiety should be considered as an important preventive issue, where mechanism-focused interventions should be included.

Although the combination of mental health promotion, prevention and early intervention should be implemented throughout the lifespan, Solmi et al. (2022) emphasize that targeted early identification of mental health problems, prior to the onset of symptoms, is the most beneficial.

1.1.1. Prevalence, incidence and global trends of adolescent anxiety

Anxiety symptoms are the most commonly reported mental health issue in adolescence. A meta-analysis of 29 studies carried out by Racine et al. (2021) reports that one in five, or about 20% of adolescents show clinically significant symptoms of anxiety. Although these findings focus on symptom level assessments, they provide valuable information on the state of adolescent mental health. First, by reporting prevalence at the level of symptoms, rather than formal diagnosis, Racine et al. (2021) emphasize the scale of mental health impairment concerning anxiety in adolescence. Secondly, these results report *clinically significant* symptoms, implying that the prevalence of anxiety symptoms, that do not reach level of clinical significance is even higher, which underscores how prominent this mental health issue has become prominent.

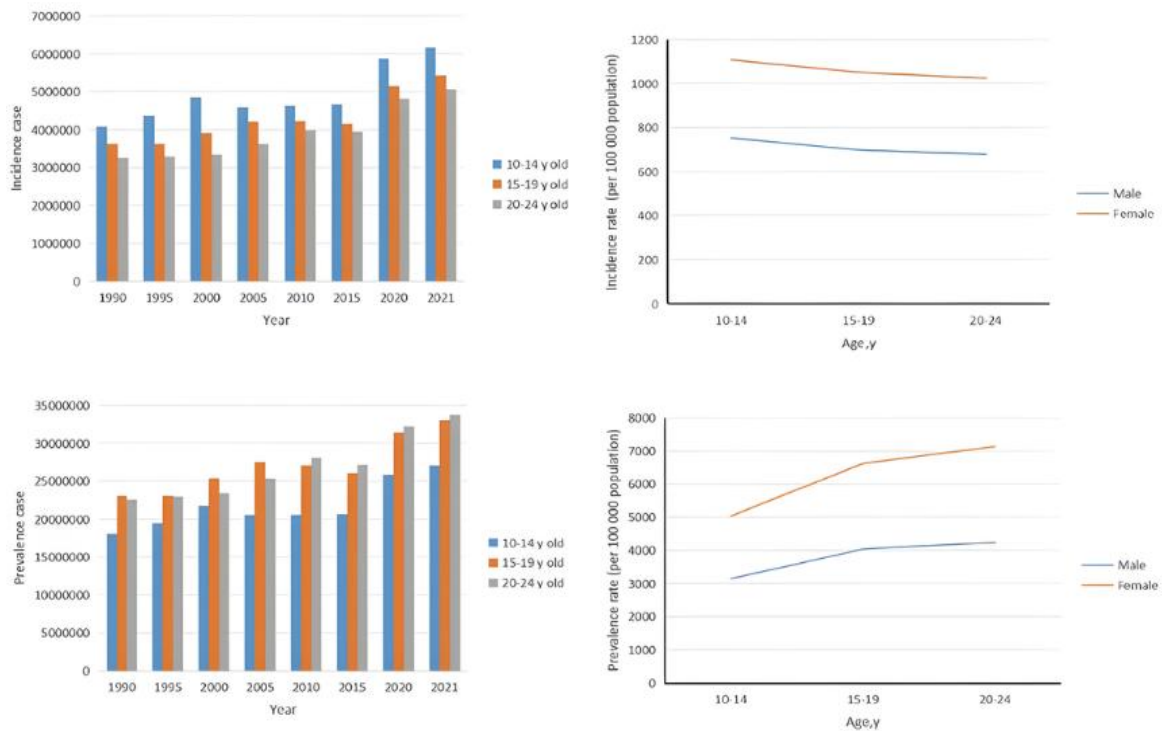
Anxiety symptoms are especially common in later adolescence, with estimates indicating that 5.3% of adolescents between the ages of 15 and 19 experience impairment at the level of anxiety disorders (World Health Organization, 2024). Global trends reported by Bie et al. (2024) show that the global incidence of anxiety disorders in youth aged between 10 and 24 years has increased by 52% in the period from 1990 to 2021. The steepest increase has been seen after the onset of the global pandemic in 2020, with adolescents aged 10 to 14 years showing the highest incidence rates of anxiety reported in 2021 (Bie et al., 2024).

Furthermore, higher anxiety rates are reported in female than male adolescents, across all age groups and considering both incidence (Bie et al., 2024) and prevalence rates (Racine et al., 2021). The reported gender differences might reflect a greater tendency toward worry and negative cognitions in females (Espinosa et al., 2022) and possibly higher levels of reported interpersonal stressors in females when considering depression symptoms among adolescents (Milas et al., 2025a). Detailed incidence and prevalence rates are presented in Figure 1.

Considering contextual differences in trends, Bie et al. (2024) report that Western Europe showed the highest incidence and prevalence rates in adolescent anxiety, with incidence rate reporting higher than the global average.

Figure 1

Graphic representation of incidence and prevalence rates for adolescent anxiety from 1990 to 2021 (retrieved from Bie et al., 2024)



Note. Upper graphs show incidence rates of adolescent anxiety by age group and year (left) and gender and age (right); Lower graphs show prevalence rates of adolescent anxiety by age group and year (left) and gender and age (right).

1.1.2. Anxiety among Croatian adolescents

Recent prevalence data of anxiety in Croatian adolescents are reported within the research project *Longitudinal adolescent stress study* (STRESS LOAD project 2021-2025) carried out by the Institute of Social Sciences “Ivo Pilar”. Longitudinal data on 3897 secondary school students, aged 15 to 17, reported similar levels of internalizing problems, anxiety and stress levels in Croatian adolescents to those observed globally. Prevalence of clinically significant symptoms of anxiety differed by gender and were reported higher for female (11 to 20%) than for male (3 to 6%) adolescents (Milas et al., 2025b). Reported gender differences were large and stable (Cohen’s $d = 0.56$ to 0.79 , depending on the assessment wave). Prevalence rates of adolescent anxiety reported by Milas et al. (2025b) are comparable to rates reported for Spanish (Casares et al., 2024) and Finnish (Tiirikainen et al., 2019) adolescents assessed by the same measure.

Novak et al. (2021) reported the pre-pandemic prevalence of anxiety among Croatian adolescents, suggesting that one in three adolescents showed severe anxiety symptoms. More recent assessments of adolescent mental health suggest that adolescents report fewer anxiety symptoms than researchers expected (Novak et al., 2023). However, it should be noted that measurement instruments used in Milas et al. (2025b) and Novak et al. (2023) differ.

While these results are relevant for further epidemiological research and provide valuable information for prevention concerning adolescent anxiety, a more comprehensive and nationally representative assessment of adolescent mental health is needed for developing timely and appropriate preventive actions. Finally, considering the lack of a nationwide prevention strategy focused on (adolescent) mental health, further epidemiological and translational research to advocate for development and implementation of a national prevention strategy is essential.

1.1.3. Etiological models of anxiety

While the research on adolescent anxiety is broad, various theories and models aim to provide a broader framework for understanding this psychopathology. However, anxiety symptoms vary in intensity and occurrence, and can, therefore, be categorized into various disorder categories (American Psychiatric Association, 2022), which makes etiological understanding of this mental health problem all the more complex. This dissertation adopts a perspective in which anxiety is considered not only as a common symptom, but as the focal outcome of stress appraisal and sensitization pathways. Accordingly, relevant models of anxiety, focusing on generalized anxiety disorder and broader anxiety symptoms, are presented and discussed. Emphasis is put on Beck's cognitive theory (Beck, 1976; Beck & Clark, 1997) and Wells' (1995, 1999) cognitive model of generalized anxiety, as the two have been commonly recognized as the leading theoretical models of anxiety, supported by empirical evidence.

1.1.3.1. Neurobiological models of anxiety

Neurobiological, or neurotransmitter-based, theories of anxiety define anxiety as the result of an imbalance in neural processes. Dysregulation of neurotransmitters such as serotonin, noradrenaline, and GABA has been associated with increased anxious reactivity and reduced fear inhibition in adolescents (Ressler & Nemeroff, 2000). Imbalance in neural communication, combined with heightened sensitivity of the amygdala and prefrontal cortex,

central neurological structures responsible for emotion regulation (Phelps & LeDoux, 2005), is considered to be the core driver of adolescent anxiety. Neuroimaging studies have investigated the neural networks that play a key role in heightened adolescent emotionality, with researchers pointing out that the key neural networks underlying socio-emotional learning connect the striatum, limbic system, and prefrontal cortex (Guyer et al., 2016). Increased activation in the prefrontal cortex is seen during cognitive reappraisal (Guyer et al., 2016), a process underlying emotion regulation, and closely associated with mindfulness (Desrosiers et al., 2013). Research suggests that this activation is more prominent in later adolescence, reflecting the ongoing maturation of brain structures involved in cognitive control. Overall, neuroimaging studies indicate that cognitive processes underlying emotional regulation increase with maturation of the prefrontal cortex and age (Guyer et al., 2016).

Neurobiological models of anxiety are particularly relevant for understanding the onset of anxiety during adolescence. This developmental period is marked by the maturation of brain structures, which may make adolescents particularly sensitive and vulnerable to stress in situations where environmental demands exceed their coping capacities. Consequently, this contributes to heightened emotional reactivity and predisposes adolescents to emotional dysregulation (Casey et al., 2010; Tottenham & Galvan, 2016). The neurobiological models do not substantially explain individual differences in anxiety outcomes, nor the subjective experience of stressful situations that lead to this outcome. While such models only address the biological aspects of anxiety, they do not explain how anxiety symptoms persist and later translate into a more serious psychopathology. In addition, these models do not consider the development of anxiety within a broader developmental or ecological context, thus underestimating the role of risk factors important for the preventive approach. Although such models are useful for understanding anxiety vulnerability and sensitivity, they need to be considered alongside cognitive, behavioral and developmental models that provide a broader preventive perspective which accounts for risk and protective factors.

Finally, the important information that neurobiological models provide is the understanding of emotional dysregulation, cognitive control and maturation of the brain structures during adolescence. When considered in the broader context of mindfulness mechanisms that promote cognitive reappraisal and emotional regulation, this is a valuable information that translates into the development of interventions targeted at individuals who show increased emotional dysregulation beyond developmentally appropriate.

1.1.3.2. Cognitive models of anxiety

A more comprehensive model of anxiety is Beck's cognitive model. Based on cognitive-behavioral principles, this model explains the cycle of onset and maintenance of anxiety symptoms (Beck & Clark, 1997). Beck integrated the ABC model (Ellis, 1994) into the broader cognitive model of anxiety, emphasizing that anxiety is an outcome of the interplay between event evaluation and underlying automatic cognitive processes. The ABC model, proposed by Ellis (1994) is central to Beck's model of anxiety. The ABC model explains anxiety occurrence, as the interplay between (*A*) adversity, or an activating situation that triggers anxious physiology; (*B*) the individual's beliefs and perception of the situation (including thoughts); and (*C*) consequences, or the emotional and behavioral symptoms of anxiety. According to Ellis (1994), irrational beliefs are the driver of emotional distress.

Building on the ABC model, Beck (1976) proposed the cognitive model of emotional problems, including both depression and anxiety. In this model, specific internalizing problems are differentiated based on their cognitive profile. Thereby, depression is characterized by the negative cognitive triad, while threat-related cognitions characterize anxiety. Beck notes that these cognitions are both anticipatory in nature, where the individual expects physical or psychological threat, and relate to the perception of vulnerability when faced with danger (Beck et al., 1985; Clark & Beck, 2010).

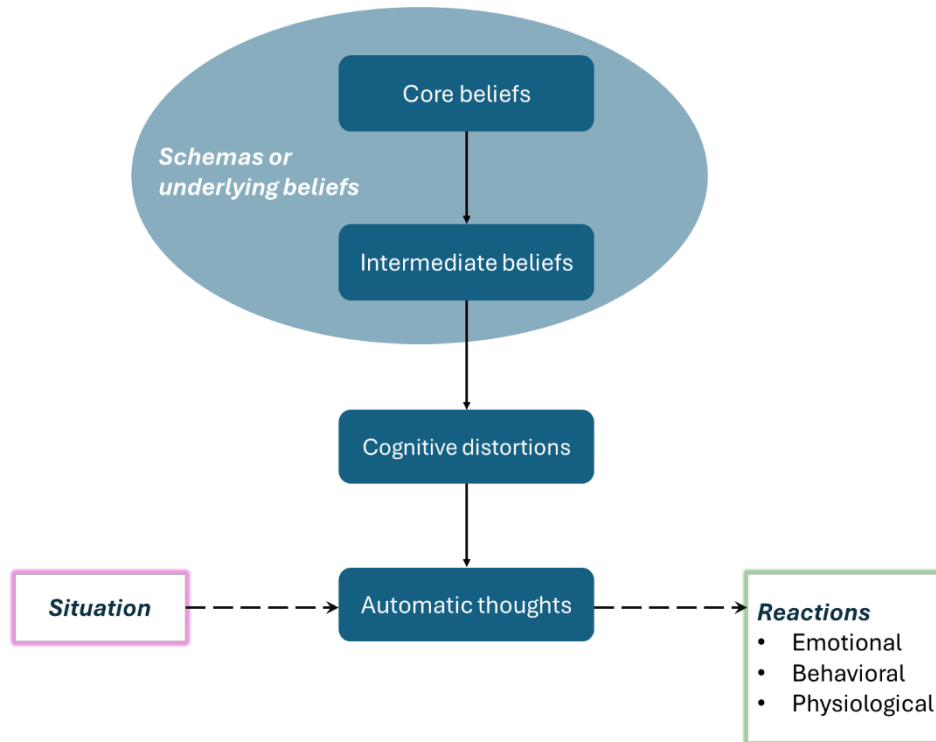
This model was further expanded by Beck and Clark (1997). It explains that anxiety occurs as a result of information processing. Accordingly, anxiety results from cognitive distortions that occur within the initial stage of information processing. Biased cognitions (or schemas) activate the threat mode, where the individual perceives the situation as threatening. These schemas become overactive danger schemas in anxious individuals, which narrow attention and produce a physiological response to threat. This then further increases the anxiety reaction (Beck & Clark, 1997). In the final stage of information processing, Beck and Clark (1997) emphasize the importance of the higher-order cognition such as conscious appraisal and re-evaluation of safety, as crucial for deactivation of mentioned automatic cognitive schemas. Important to note here is that Beck and Clark (1997) understand cognitive schemas as cognitions that have developed based on individual's previous experience. When considered from an adversity perspective, these cognitive schemas are formed during development (Beck & Clark, 1997), and are thus closely related to exposure to adversity (or stressful life events) and are associated with the later stress appraisal threshold.

Empirical research supports Beck's cognitive model of information processing and maladaptive cognitions and suggests that anxiety in adolescence is highly related to negative automatic thoughts, selective attention and repetitive cognitions such as catastrophizing (Wells et al., 2020). While these mentioned processes are often grouped under the term of automatic cognitions, Chand et al. (2023) differentiate these cognitive concepts to three categories. Automatic thoughts are seen as immediate (and often distorted) interpretations of the situation, and they shape the individual's emotional, behavioral and physiological reactions. Cognitive distortions represent habitual errors in logic that produce negative thinking (e.g., catastrophizing). Finally, cognitive schemas or beliefs are shaped through development (Beck & Clark, 1997) and represent basic rules for information processing (Chand et al., 2023). Cognitive schemas are understood at the level of *core beliefs* that represent the fundamental level of beliefs about the self and the world, and *intermediate beliefs* that are often conditional, and include attitudes and rules (Chand et al., 2023). Finally, automatic thoughts are considered to be the most important level of cognitive processing that can be modified by therapy or interventions. Accordingly, automatic thoughts are commonly included in the empirical research that focuses on understanding the underlying mechanisms concerning anxiety. A detailed hierarchy of information processing is presented in Figure 2.

Beck's cognitive model has been applied across anxiety disorders, with the model being especially promising in the conceptualization and treatment of generalized anxiety disorder. Beck was one of the first to propose the conceptual model of generalized anxiety disorder (Beck et al., 1985), noting that the common theme in generalized anxiety disorder model is inflated safety-seeking behavior that individuals use to mitigate perceived threat.

Figure 2

Proposed hierarchy of processes in the cognitive model of anxiety based on Beck & Clark (1997), Clark & Beck (2010)



Wells (1999) further developed this model and proposed the metacognitive model of generalized anxiety disorder (GAD), which further explains how GAD is maintained. Wells (1995, 1999) distinguishes between Type 1 and Type 2 worry. Type 1 worry refers to everyday worry and rumination about possible negative outcomes, and is relatively common. On the other hand, Wells (1999, 2005) refers to Type 2 worry as the meta-cognitive worry, characterized by negative appraisal about one's own worrying process. According to Wells (1995, 1999, 2005) this worry is central to the maintenance of generalized anxiety. Furthermore, this broader GAD model proposes that worry is sustained by two different types of metacognitive beliefs. First are positive metacognitive beliefs, which Wells (1995, 2005) describes as perceiving worry as a coping mechanism, where worrying prepares the individual for difficulties and thus possibly prevents negative outcomes. In this view, worry is considered as a self-regulatory mechanism. By contrast, negative metacognitive beliefs relate to perceived uncontrollability where worrying is considered to be negative and threatening. Wells (1995, 2005) notes that negative beliefs are central to generating metacognitive worry characteristic of generalized anxiety disorder. These beliefs subsequently sustain the process in which worrying about worrying

becomes both the trigger and the maintaining factor of anxiety. Empirical research supports this model, with data indicating that maladaptive cognitive beliefs measured in early adolescence, predict later onset of anxiety levels (Ellis & Hudson, 2010; Esbjørn et al., 2015).

The presented cognitive models of anxiety are of particular importance in the context of prevention planning, as they identify key cognitive processes that maintain anxiety. These models provide information on possible cognitive vulnerabilities such as maladaptive cognitions, and heightened worry beyond what is developmentally appropriate, which presents prior to the onset of anxiety and constitutes a risk factor for developing more severe psychopathology. Therefore, focusing early prevention on the underlying processes that contribute to and maintain later more serious mental health problems, allows for preventive actions without the need for diagnosis, or before the onset of clinical symptoms emerge. Finally, cognitive models indicate exact cognitive mechanism that can be modified and targeted (e.g., automatic thoughts and rumination) by mindfulness-based interventions, or other socio-emotional learning skills, which makes these programs acceptable within the broader educational context.

1.1.3.3. Developmental models of anxiety

Developmental etiological models place the onset of anxiety within early life and understand it as a result of early adversity and vulnerability. Rapee et al. (2009) posit the onset of anxiety within a broader developmental framework, focusing on understanding why anxiety develops in some children and adolescents but not others. According to Rapee et al. (2009), adolescent anxiety is a result of the interaction between individual and environmental factors. Thus, anxiety is understood as an outcome of interplay between the individual's temperament, early adversity, social environment and learnt behavioral patterns. Accordingly Rapee et al. (2009) distinguish between broader domains of etiological factors: (1) temperamental factors, (2) cognitive factors, (3) family-related factors, and (4) social experiences (such as life events, and behavior modeling).

Rapee et al. (2009) emphasize the importance of the social environment and life events that largely contribute to the development of anxiety, which is why authors (Rapee et al., 2019) later conceptualized generalized anxiety disorder as a socio-emotional disorder, alongside depression and eating disorders. Within this model, Rapee et al (2019) identify developmental changes that contribute to the development of anxiety in adolescents. First, pubertal changes and hormonal imbalance are noted as risk factors that contribute to heightened emotional

reactivity, sleep disruption and physical changes, all of which increase distress levels. Second, cognitive changes associated with self-evaluation and social evaluation contribute to sensitivity to social rejection, as well as to distorted perception of social cues. At the same time, metacognition develops, which allows adolescents to ruminate about past experiences, and worry about the future. Finally, peer relationships change and become more complex, and romantic relationships develop. All of which present new areas of adolescent development that are more vulnerable to stress. Notably, Rapee et al. (2009, 2019) suggest that the aforementioned changes do not cause anxiety directly but rather contribute to its development when paired with existing vulnerability.

Important for the prevention framework is the identification of periods and environments in which certain anxiety vulnerabilities can be mitigated or prevented. Additional risk factors identified at the individual level that increase the risk of adolescent anxiety are female gender and temperament characterized by behavioral inhibition (Rapee et al., 2009). Moreover, certain personality traits such as neuroticism and low self-esteem also contribute to the development of anxious symptoms in adolescence (Steinberg, 2005, according to Rapee et al., 2019). However, of particular relevance to this research are cognitive biases in information processing such as selective attention (Beck & Clark, 1997) and low tolerance for uncertainty (Carleton et al., 2012), as risk factors that significantly increase the likelihood of developing anxiety. Finally, an individual's history of trauma, adversity and exposure to at least one negative life event, is associated with a significant risk of developing anxiety during adolescence (Allen et al., 2008, according to Rapee et al., 2009).

1.1.4. Adolescent vulnerability

The abovementioned etiological theories identify risk factors and mechanisms that contribute to the development and maintenance of anxiety. The following section focuses on understanding adolescence as a specific life period, when biological, social and individual factors pose additional risk to mental health.

Throughout literature, adolescence has always been referred to as the period of “*storm and stress*”, describing this turbulent and sensitive developmental period when adolescents face changes in the biological, emotional, cognitive and social domains (Blakemore, 2019), and are exposed to new stressors (Arnett, 1999, 2012). Although many overcome these changes as merely developmental challenges, others lack adaptive skills and are thus more prone to developing mental health difficulties (Blakemore, 2019). However, the additional vulnerability

of this period is mostly seen in biological and social changes that contribute to later mental health trajectories.

Neurobiological changes include both structural and functional changes in brain structures, including the prefrontal cortex and amygdala. During adolescence, subcortical structures including the amygdala, responsible for emotion processing, mature significantly earlier than the prefrontal cortex (Paus et al., 2008). Considering that the prefrontal cortex is involved in cognitive control and emotion regulation, this uneven maturation results in neurobiological imbalance that explains why adolescents show strong emotional reactions, with limited regulating capacity (Casey et al., 2008; Steinberg, 2008). Additionally, hormonal changes contribute to this imbalance by altering the reactivity of HPA axis, thus increasing emotional response to social stressors (Stroud et al., 2009). These neurobiological changes make adolescents' nervous system highly reactive but not adequately equipped with regulatory mechanisms that would allow them to manage emotional reactivity. Guyer et al. (2016) suggest that this dysregulation, manifesting through heightened emotionality in adolescence, is a core contributor to increased psychopathology outcomes.

However, Fuhrmann et al. (2015) suggest that the changes in brain structures also affect neuroplasticity in adolescence. This has both positive and negative implications for adolescent vulnerability. Negative aspects of neuroplasticity include the vulnerability of circuits involved in emotional regulation to chronic stress in various life domains (e.g., family or peer relationships), which results in priming those neural pathways toward an anxiety response (Fuhrmann et al., 2015). However, neuroplasticity suggests that the adolescent brain is highly responsive to positive input, making this developmental period a valuable opportunity for structured prevention.

Arnett (1999, 2012) characterized adolescence as the period of instability and identity exploration, which reflects broader social changes. Considering social aspect, Lin and Guo (2024) present three levels of social changes that are closely interconnected: individual, family and the broader social level. The individual level includes changes in self-esteem and self-efficacy, that are closely related to mental health trajectories and are often shaped by the other two social levels. Further changes in adolescence are reflected in family dynamics, where adolescents seek more autonomy, while specific family characteristics are recognized as both risk (e.g., negative life events, or parents' socioeconomic status) and protective factors (e.g., family connection) of adolescent mental health (Lin & Guo, 2024; McLaughlin et al., 2012;

Novak et al., 2021). Within the broader social level, changes in peer relationships are most prominent, where negative social interactions such as bullying and victimization, are directly related to poorer mental health outcomes. By contrast, school attachment and commitment are seen as protective factors and relate to reduced stress and anxiety during adolescence (Novak et al., 2021).

In conclusion, adolescence poses additional vulnerability for mental health trajectories, considering rapid changes in various life domains. Mental health problems that emerge during adolescence affect (mal)adaptive coping skills (Milas et al., 2019). When this (in)adequate coping is combined with prolonged stress exposure, it significantly impacts future mental health outcomes including broader coping capabilities and resilience resources. Therefore, the state of mental health during adolescence carries both short- and long-term implications for overall psychological functioning and prevention planning. Although neuroplasticity poses a vulnerability to stress exposure during this developmental period, socio-emotional skills taught in this period have greater potential to be fully consolidated. This constitutes a strong argument for delivering preventive interventions during this developmentally vulnerable period. Simultaneously, prevention programs implemented in adolescence would provide necessary skills that promote adolescents' coping capacity before stress accumulates, which then significantly shifts mental health trajectories from symptom severity and disorders to well-being and flourishing.

1.2. Stress

Adversity and chronic stress have been identified as significant etiological risk factors that not only contribute to the development of anxiety, but also contribute to its maintenance and possible exacerbation to more severe mental health problems (Slavich, 2016). Stress is often central to (adolescent) mental health research that reports direct, strong and often bidirectional associations between these constructs (Slavich, 2016), suggesting that the relationship between stress and anxiety is highly complex. A recent meta-analysis done by Nochaiwong et al. (2021) reports that the global prevalence of significant psychological stress reaches 36.5%. While research focusing on mental health mainly investigates stress and anxiety as outcome variables, this dissertation will closely focus on the process perspective, examining specific stress pathways that contribute to adolescent anxiety. Similarly, although the relationship between stress and anxiety has been empirically established (Slavich, 2016),

researchers in this field note that the large scope of stress research has been methodologically limited. Therefore, this chapter focuses on the (dual) conceptualization of stress, integral to the understanding of stress processes, and discusses the main theories that shaped the stress-anxiety process perspective. Notably, various theories give separate understandings of stress, however, this chapter will encompass the two main models relevant to understanding how stress relates to adolescent mental health and contributes to anxiety outcomes.

1.2.1. Conceptualizing stress: Objective stress exposure and subjective stress

Despite the vast research conducted on stress, recent emphasis has been put on the conceptualization of stress as being overly complex. For a long time, researchers have implied physiological, psychological, and environmental stressors under one and the same term – stress. Thus, making the construct overly complex, and findings less reproducible across the field (Epel et al., 2018; Slavich, 2020). O'Connor et al. (2021) report that the conceptualization of stress as a primarily psychological construct has come under question, with some researchers (Kagan, 2016; McEwen & McEwen, 2016) emphasizing the importance of biological outcomes in understanding stressors, while others argued that a more comprehensive understanding of stress, encompassing psychological, biological and epidemiological aspects, is needed (Cohen et al., 2016). Therefore, O'Connor et al. (2021) noted that careful conceptualization of stress is important to fully distinguish underlying aspects of what is commonly measured under the broader stress term. Slavich (2019) has proposed '*stressnology*' to emphasize the problem of studying the effects of life stress on overall health. While the general "stress" term often refers to both stressor exposure and individuals' stress response, and sometimes even considers processes that may moderate this relationship (e.g., coping), Slavich (2019) urges for methodologically better measurements and distinct conceptualizations of stress. In a conceptual review on life stress research, Slavich (2016) recognized three dominant approaches to the conceptualization of stress. The first approach concentrates on stress stimuli and locates them in the environment. The second approach focuses on stress response and concerns individual biological and psychological reactions. The third approach transitions between the prior two. Thus, Slavich (2016) argues that the lack of consensus on stress conceptualization directly limits the comparability and later replicability of findings. Therefore, defining stress in theoretically precise terms that allow for empirical reproducibility should be a methodological prerequisite of the field. Slavich (2016) emphasized that this issue is of additional importance when researching stress across development, where the impact of stress varies depending on prior adversity and broader social context.

The recent literature in the field of the psychology of stress recognizes that this construct is best understood as a multi-component process. Epel et al. (2018) proposed a transdisciplinary model that integrates all prior conceptualizations of stress, and simultaneously distinguishes stressor exposure, psychological stress responses and physiological reactions. These aspects are seen as conceptually distinct, but dynamically interrelated components of stress. The framework proposed by Epel et al. (2018) considers how stressors from what Slavich (2020) defines as the socio-environmental level translate to the individual level that encompasses the psychological experience of stress. An important contribution of this conceptual model concerns the pathway through which stressor exposure accumulated across life calibrates the habitual stress response in a way that changes the threshold at which acute stressors provoke physiological reaction (Epel et al., 2018).

Objective versus subjective stress

The important conceptual distinction in the context of this research is the one between objective stressors and subjective (or perceived) stress. Objective stressors refer closely to the socio-environmental events that occur independently of the individual stress response and appraisal. Under the category of objective stressors, Slavich (2020) positions major (negative) life events, chronic role stressors, interpersonal conflicts, and socio-economic adversity. Objective stressors are often measured using checklists or interviews that assess the occurrence and severity of discrete categories of stressor exposure (Shields & Slavich, 2017; Slavich & Shields, 2018; Slavich, 2020), thus not measuring emotional reactions as the primary stress outcome (O'Connor et al., 2021). By contrast, subjective or perceived stress refers to the psychological experience of stressful stimuli. These responses include the broad spectrum of negative emotions (e.g., sadness, overwhelm, and fear) and often include individuals' coping capabilities. Subjective stress implies a psychological state that is often shaped by prior sensitization, cognitive appraisal, physiological reactivity and other situational factors. It must therefore be distinguished from objective stressors during assessment (Epel et al., 2018).

This conceptual distinction has been supported by empirical research that shows that objective stressors and subjective stress exhibit moderate, but not full, correlations. Moreover, as conceptually distinct constructs, the two stress measures have been reported to independently predict distinct mental health outcomes and are differentially moderated by individual factors and adversity (O'Connor et al., 2021). Therefore, the same stressor (e.g., family conflict, or a health problem) might produce different levels of perceived stress in one adolescent, but

clinically significant level of stress in another, depending on individual cognitive appraisals and the stress threshold that is shaped by prior adversity. Notably, Epel et al. (2018) note that subjective stress encompasses the affective and cognitive levels of appraisal.

Finally, this conceptual distinction has direct methodological implications that concern both the measurement of stress and the interpretability of research findings. Croswell and Lockwood (2020) note the need for dual measurement of stress in their methodological review of best practices for stress measurement. The authors (Croswell & Lockwood, 2020) suggest that researchers should specify whether the stress construct was measured as stressor exposure, a psychological stress response, or a biological stress response, while this distinction largely shapes both the interpretability of findings and the validity of associations between stress and health outcomes. Epel et al. (2018) additionally state that including only one measure of stress, likely reduces the overall association between stress and health outcomes. On the other hand, including only subjective stress measure neglects the contribution of stressor exposure. Thus, studies that assess only the count of objective stressors risk undermining the comprehensive understanding of stress appraisal process (Epel et al., 2018). Therefore, a methodologically rigorous approach to stress assessment, that includes both objective stressors and subjective or psychological stress, is needed when considering adolescent stress and health outcomes.¹

1.2.2. Transactional Model of Stress and Coping

Distinction between objective and subjective stress presented above implies that there is an underlying mechanism that shapes how the mere occurrence of stressful event translates to the individual's perception of the event as stressful. The Transactional Model of Stress and Coping proposed by Lazarus and Folkman (1984), further explains this underlying mechanism. According to Lazarus and Folkman (1984, 2004), (automatic) cognitive appraisal translates objective stressors into subjective (or psychological) stress appraisal. While the present

¹ Objective stress (or objective stressors) is conceptualized as stressor exposure and is measured as count and/or severity. Subjective stress is conceptualized as stress appraisal. However, subjective stress is also related to as a psychological or perceived stress. Therefore, the terms *subjective stress* and *psychological stress* will be used throughout this dissertation interchangeably and will regard stress appraisal. Objective stress(ors) and stressful life events will be used interchangeably and will regard count of stressful life events.

dissertation models the relationship between objective and subjective stress, this transactional model is positioned as the core theoretical foundation of the proposed stress pathways.

Lazarus and Folkman (1984, 2004) proposed that stress is not merely a result of an occurred stressful event but rather a result of the interaction between stressful events and the individual. Accordingly, this model accounts for environmental adversity and individual's perception of coping capacity in relation to that adversity. Cognitive appraisal is at the center of the transactional model (Lazarus & Folkman, 1984, 2004), and largely shapes the interpretation of the stressful event as either threatening or beneficial, and also directs the individual's emotional and cognitive response to the event.

Lazarus and Folkman (1984) distinguish between two subsequent appraisal processes. The first is the *primary appraisal* during which the individual evaluates if the situation is irrelevant, benign or stressful. Irrelevant or benign evaluations usually do not lead to a stress response, regardless of the objective stressfulness of an event. However, stressful evaluation further distinguishes between the evaluation of an event as harmful, threatening (which reflects anticipated damage, and is closely relevant to anxiety), or challenging. *Secondary appraisal* relates to the evaluation of what can be done to overcome perceived stressfulness. Therefore, the secondary appraisal includes the evaluation of coping resources, where Lazarus and Folkman (1984, 2004) distinguish between problem-focused coping and emotion-focused coping.

According to Lazarus and Folkman (1984), stress arises when an individual appraises the situation as a threatening, while their internal capacity for coping is not adequate and situational demands exceed available coping resources. The interaction between these two appraisals is what determines the extent of the stress response. Therefore, not all individuals will exhibit the same stress response to the same stressful events, underscoring the importance of subjective appraisal in this process. This is especially relevant to the present dissertation, where the transactional model suggests that how a stressor is perceived matters, and that subjective stress appraisal mediates the relationship between stressful events (or objective stress) and later mental health outcomes. Empirical research on this specific mediation in adolescents is still lacking. Longitudinal adolescent studies have only directly linked higher exposure to stressful life events to later internalized problems (e.g., Cortazar et al., 2019), without modeling stress appraisal as an important aspect of the broader stress process. This dissertation extends the conceptual framework of the Transactional Model of Stress and Coping

(Lazarus & Folkman, 1984), by testing whether subjective stress appraisal carries the effects of sole exposure to stressful life events, on later adolescent anxiety symptoms.

Moreover, Lazarus and Folkman (1984, 2004) suggest that cognitive appraisal, which is at the center of this model, usually operates rapidly, at the unconscious, automatic level of processing. This has direct implications for the present research, where mindfulness is later positioned as a factor that moderates the relationship between objective and subjective stress, while also contributing directly to subjective stress appraisal. Furthermore, automatic cognitive processing is especially relevant to the adolescent period, when emotional regulation shaped by the maturation of the prefrontal cortex is still developing (Paus et al., 2008). Finally, while the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) is central to the theoretical foundations of the present research, this model does not explain how appraisal tendencies (evaluating events as stressful or beneficial) develop. Therefore, this model is integrated with the stress sensitization model, which explains how prior stress exposure alters the appraisal threshold.

1.2.3. Stress sensitization model

The stress sensitization model proposes that individuals become sensitized to stress over time, suggesting that the threshold of stress which is required to trigger the onset of mental health problems becomes lower with accumulated exposure to adversity (Stroud, 2020). This model originated in Post's (1992) kindling hypothesis. Post (1992) suggested that the first episode of an affective disorder was likely preceded by major life stressors, compared to later episodes. Based on the electrophysiological kindling and behavioral sensitization mechanisms, Post (2007, as cited in Stroud, 2020) expanded this hypothesis, and suggested that early adversity (i.e., stressful life events) leads to epigenetic changes that increase the individual's sensitivity to later proximal stressors. It was proposed that the sensitization mechanism was reflected in gene transcription where long term memory of early adversity was encoded.

Monroe and Harkness (2005) criticized Post's hypothesis, suggesting that sensitization did not distinguish between episode sensitization and stress sensitization. Episode sensitization implies that the sole experience of an affective episode results in trait vulnerabilities that contribute to later affective episodes, which occur at lower stress thresholds. For example, a history of a depressive episode, contributes to neurobiological vulnerabilities and changes in gene expression, which in turn lowers the individual's threshold for having depressive episodes again (Stroud, 2020). Stress sensitization implies that both early life stress and stress

experienced later in life, individually trigger vulnerability. This vulnerability then increases sensitivity to future stressors, regardless of whether the stress reaches the threshold needed to trigger an affective episode. Thus, each stressful experience may or may not reach the threshold needed for triggering an affective episode, but it leads to vulnerability expressed in epigenetic changes that lower future thresholds. To distinguish between the two mechanisms, Monroe and Harkness (2005, as cited in Stroud, 2020) argued that understanding the difference between the impact and frequency of stressful events is crucial. Accordingly, stress sensitization predicts that the impact of both major and minor stressful events increases with subsequent affective episodes, even if their frequency decreases.

Stroud (2020) expanded the understanding of sensitization mechanisms and proposed that stress sensitization occurs through sensitization of prior episodes and early adversity. The sensitization effect of prior episodes is reflected in changes in the HPA axis, heightened cortisol and glucocorticoid reactivity, and rumination, all of which are closely related to depression and generalized anxiety disorder (Stroud, 2020). Furthermore, sensitization through early adversity was reflected in HPA axis dysregulation, negative cognitive schemas, and diminished cortisol reactivity. Alterations in the stress response system due to early adversity sensitization were linked to later internalizing psychopathology outcomes (Stroud, 2020). McLaughlin et al. (2010) support this relationship, suggesting that individuals who experienced two or three major early adversities had double the increased risk of depression onset, compared to the group without early adversity. The impact of early adversity on later stress sensitivity was also observed in adolescents, suggesting that adolescents with history of adversity were more likely to develop depression when faced with lower levels of proximal stress (Stroud, 2020).

Stroud (2020) suggests that stress sensitization and stress generation (Hammen, 1991, as cited in Stroud, 2020) exist reciprocally. Thus, individuals with a history of affective disorder are more likely to generate stress, while simultaneously being sensitive to stress when it occurs. Notably, early adversity has been identified as a predictor for both stress sensitization and stress generation.

Finally, Stroud (2020) presents broad evidence for stress sensitization in the onset of depression, bipolar disorder, and internalizing disorders, while little evidence supports the role of stress sensitization in relation to anxiety. However, assuming the existence of sensitization mechanism in the development of anxiety is reasonable due to the documented cognitive and behavioral vulnerability seen in anxiety symptomatology (McLaughlin et al., 2014).

Additionally, Stroud (2020) suggests that additional understanding of the stress sensitization mechanism is needed. Evidence suggests that sensitization operates through cognitive processes (e.g., rumination, and negative thinking). However, examining this pathway alongside mechanisms that alter cognitive and emotional processing, such as mindfulness, might provide valuable insight into protective mechanisms that can be modified through interventions.

1.3. Mindfulness

Research on mindfulness has become increasingly prominent in recent decades. Kabat-Zinn (1990; 2003) proposed the core definition of mindfulness, and with this introduced mindfulness to research fields across Western culture. Thus, mindfulness has become particularly prominent in research areas related to mental health, stress, and psychopathology.

1.3.1. Mindfulness construct

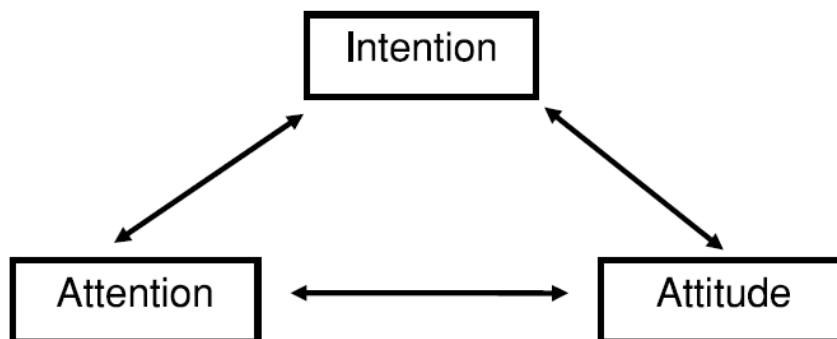
Kabat-Zinn (2003) defines mindfulness as awareness that encompasses directing focus on aspects of the present moment, including bodily sensations, thoughts, and emotions (commonly referred to as “present moment experience”), with an open, non-judgmental attitude. This definition originated in Kabat-Zinn’s (1990) integration of meditative and clinical practices through the Mindfulness-Based Stress Reduction (MBSR) program, which is considered the conceptual foundation for later empirical research on mindfulness and stress.

Further operationalizations of mindfulness have been proposed as this construct became broadly popular within the field of psychology and contemplative science. Bishop et al. (2004) argued that previous operationalizations of mindfulness have been equating this construct with self-consciousness and internal self-awareness, where the latter mainly relates to susceptibility to psychological processes within an individual. Thus, Bishop et al. (2004) proposed the two-component model of mindfulness that encompassed: (1) *self-regulation of attention*, so that attention is focused on immediate experience, and (2) *orientation toward experience*, which is characterized by curiosity, openness, and acceptance. The operationalization of mindfulness as proposed by Bishop et al. (2004) emphasizes the importance of decentering, which is crucial in the context of understanding how automatic processes such as maladaptive cognitions are maintained. Furthermore, this operational definition shaped the development of mindfulness instruments such as the Mindful Attention Awareness Scale (Brown & Ryan, 2003) and the Five Facet Mindfulness Questionnaire (Baer et al., 2006).

Shapiro et al. (2006) further proposed a model of mindfulness by defining the following axioms, or fundamental components of mindfulness, that are interrelated and occur simultaneously in a single mindfulness process (presented in Figure 3): (1) *intention*, as the central component of mindfulness, relating to *why* someone is practicing, (2) *attention*, which includes observing moment to moment external and internal experience, and (3) *attitude*, which reflects the qualities of attention, or *how* individual is observing this experience. However, last component does not imply evaluation of the situation as either good or bad, but rather an attitude of acceptance, kindness and openness towards the experience. This model emphasized that mindfulness is not only a cognitive skill, but rather a relational stance toward current experience. Therefore, Shapiro et al. (2006) suggest that mindfulness alters how individuals process and respond to internal stimuli, emphasizing that mindfulness should not be understood only as a technique that eliminates stress or anxiety, but rather as a capacity that alters experience. Thus, mindfulness is seen both as a process and an outcome (Shapiro, 2009).

Figure 3

Three interrelated axioms of mindfulness, as proposed by Shapiro et al. (2006)



Lastly, researchers note the conceptual distinction between trait and state mindfulness. Trait mindfulness relates to a relatively stable disposition toward the tendency to be mindful (Brown & Ryan, 2003). On the other hand, state mindfulness relates to momentary quality of awareness or mindful state, that arises during experience and is often cultivated through formal practice (Lau et al., 2006). The distinction between trait and state mindfulness is important from the methodological aspect of the quality of assessment. Thus, trait mindfulness is often measured using self-reports and can be examined as a predicting or moderating variable in

broad research designs, which is reflected in the first study of this dissertation. State mindfulness, however, is usually measured during or immediately after meditation or other interventions. While state mindfulness is commonly measured in pre- and post-intervention designs, this does not necessarily imply that all mindfulness-based intervention studies examine state mindfulness. Rather, the specific time of measurement is crucial, as measuring state mindfulness aims to capture the immediate changes that occur during or after a practice or a mindfulness session (Tanay & Bernstein, 2013). Regarding mindfulness-based intervention research, pre- and post- designs mostly measure trait mindfulness using self-reports assessed at pre-intervention and post-intervention. In contrast, state mindfulness would on such occasions be measured at pre-session and post-session. Finally, research suggests that trait and state mindfulness are related, but do not reflect the same construct. Therefore, cultivating state mindfulness through formal training seems to strengthen trait mindfulness over time (Kiken et al., 2015).

Lastly, Roeser et al. (2022) suggest that mindfulness can be considered as (1) a natural mental state, (2) an educable skill, and (3) an enduring mental trait. The importance of understanding mindfulness as a skill relates to the effectiveness of mindfulness-based interventions. However, authors (Roeser et al., 2022) here emphasize the importance of engagement with mindfulness training, which supports skill development that consequently reduces stress and anxiety and supports well-being. The present dissertation focuses on whether trait mindfulness impacts stress and later anxiety, while the potential of mindfulness-based interventions to enhance this trait is examined as one of the outcome hypotheses in the second study.

1.3.2. Mindfulness and mental health

Individual differences in mindfulness levels have been associated with various psychological outcomes. Accordingly, higher trait mindfulness has been associated with lower perceived stress, greater well-being, and has predicted less negative stress appraisal in adults (Weinstein et al., 2009), suggesting that higher mindfulness positively contributes to adaptive coping. This dissertation focuses on the adolescent population, thus aiming to further explore whether same relationships are present during this emotionally less regulated period.

Literature on adolescent mindfulness and mental health suggests that trait mindfulness is strongly and negatively correlated with internalizing symptoms (Greco et al., 2011), although mostly only at the cross-sectional level. Similarly, Pepping et al. (2016) report that low trait

mindfulness is associated with higher symptoms of depression, anxiety and stress. Tan and Martin (2013a, 2013b) further supported this pattern and reported that a small mindfulness-based group program significantly contributed to reductions in depression, anxiety and stress (Tan & Martin, 2015). Lucas-Thompson et al. (2019) examined the relationships between trait mindfulness, psychological stress, cardiovascular activity and cortisol levels, reporting that higher mindfulness predicted reduced emotional stress response, and lower cardiovascular activity, thus partially confirming the mindfulness stress buffering account (Creswell & Lindsay, 2014).

Finally, Dunning et al. (2019) note in their meta-analysis that studies reported association between trait mindfulness and better psychological functioning, supporting its role as the protective factor for mental health. Considering this from the perspective of the dual mental health continuum (Keyes, 2002, 2005), trait mindfulness may not only have a promising effect in reducing psychopathology, but also in promoting flourishing.

1.3.3. Mindfulness-based interventions² for adolescents

The translation of mindfulness from solely research and clinical settings to school-based preventive programs for children and adolescents, has rapidly shifted over the past two decades. Weare (2023) proposed a retrospective review of the field of mindfulness-based interventions, where the author notes that the early enthusiasm has shifted toward a phase of critical reappraisal. Weare (2023) noted that the growing evidence base on the effectiveness and implementation of school-based mindfulness programs, revealed specific conditions regarding when, how, and for whom are such interventions most effective. The theoretical rationale for delivering mindfulness-based interventions as a universal prevention strategy in schools rests on the evidence that mindfulness skills taught in adolescence possibly strengthen self-regulatory capacity, thus having a promotive effect in contributing to positive development, before the onset of mental health problems and/or psychopathology (Kuyken et al., 2016, 2017; Roeser & Pinela, 2014). This understanding of SBMIs is aligned with the broader prevention framework. In their review of school-based prevention, Greenberg et al. (2001) proposed common characteristics of effective programs. Some of these include that programs target

² *Mindfulness-based interventions* abbreviated later in text as MBIs; *School-based mindfulness interventions* later abbreviated as SBMIs.

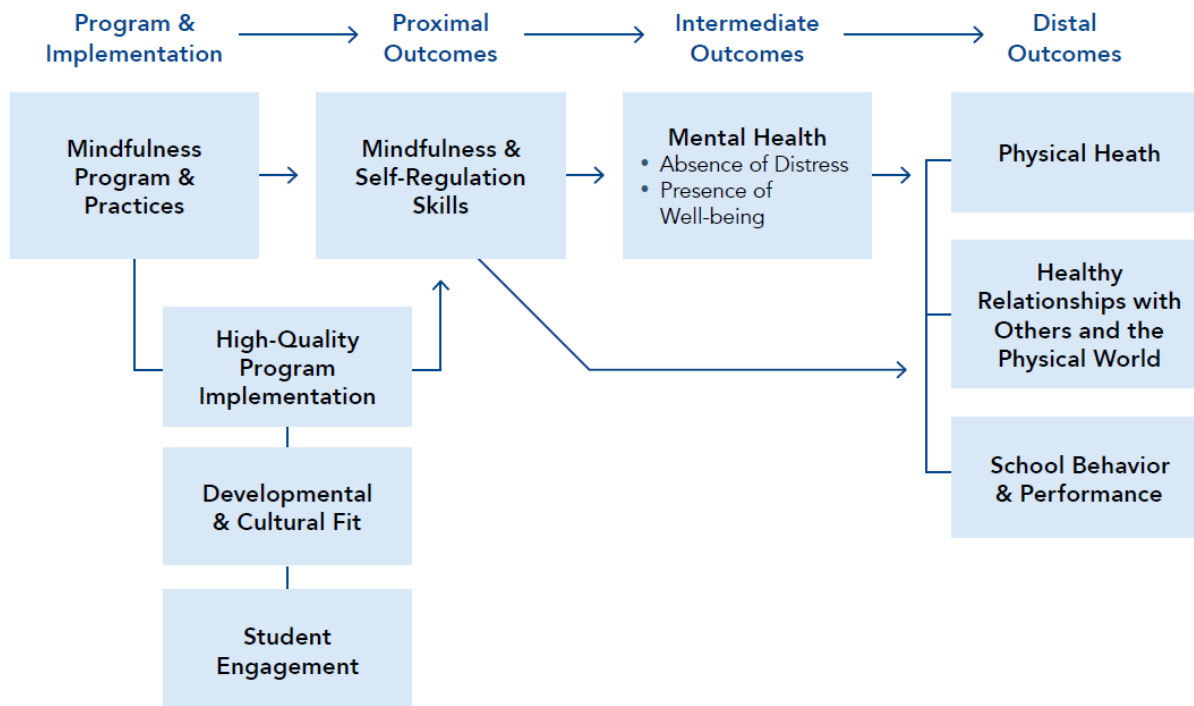
empirically established risk and protective factors, operate through specific mechanisms, and are developmentally appropriate for the population.

The research field reports ambiguous findings on the effectiveness of MBIs. While some researchers suggest that mindfulness training has positive effects on reducing symptoms of anxiety and depression (Dunning et al., 2019; Phillips & Mychailyszyn, 2022), internalized symptoms (Crowley et al., 2017; Zhang et al., 2021a, 2021b), and psychological stress in adolescents (Zhang et al., 2021a), newer meta-analyses question the benefits of universal mindfulness-based interventions.

Roeser et al. (2022) published a systematic review of 54 evaluation studies on MBIs, that encompassed over 13,000 students and 36 school-based mindfulness programs. This review suggests that school-based mindfulness programs effectively improve self-regulation skills in secondary school students, as reported for 45% of programs. Benefits of SBMIs were reported for internalizing symptoms, which included anxiety and depression outcomes, with 54% of studies showing beneficial effects in secondary students. However, little evidence has been reported for SBMIs effectiveness regarding externalizing problems and well-being outcomes. Therefore, the authors suggest that the impact of the observed benefits of mindfulness programs depends on the quality of their delivery and other implementation factors presented in the logic model proposed by Roeser et al. (2022), shown in Figure 4.

Figure 4

Logic model on impact of school-based mindfulness interventions by Roeser et al. (2022)



The meta-analytic evidence on MBIs effectiveness in the adolescent population is substantial and supports the above-presented review (Roeser et al., 2022). Dunning et al. (2019) reviewed 33 randomized controlled trials, and reported significant positive effects of MBIs concerning mindfulness, executive functions, attention, depression, stress and negative behaviors. However, interventions reported relatively small effects (Cohen's $d = .16$ to $.30$). Authors (Dunning et al., 2019) note that when only trials with active control groups were considered, the effects remained significant only for mindfulness ($d = .42$), depression ($d = .47$) and anxiety/stress ($d = .18$). In an updated meta-analysis (Dunning et al., 2022), encompassing 66 mindfulness-based programs, results at post-intervention confirmed prior evidence concerning anxiety outcomes (Dunning et al., 2019). However, the new analysis (Dunning et al., 2022) reported no positive effects for well-being, and when studies with follow-up assessments were examined, no significant positive effects of MBIs were seen.

Another comprehensive systematic review (Galante et al., 2021) of 136 randomized controlled trials, although in an adult population, distinguished between the effects when compared with no versus active versus passive control groups. Galante et al. (2021) found evidence for MBIs in reducing anxiety, depression, and stress levels. However, MBIs were not

superior when compared with active control groups, and only partially beneficial when compared to passive control groups, with effects shown only for depression. In a later meta-analysis, Galante et al. (2023) suggested that MBIs showed an overall benefit, however, effects were moderated by baseline stress levels, thus supporting the implications for benefits of targeted delivery over universal delivery.

Zhang et al. (2021a, 2021b) further supported the evidence on the benefits of MBIs and reported small positive effects on adolescent stress, anxiety and depression, with no effect on overall well-being. Phillips and Mychailyszyn (2022) supported the same findings, although suggesting that effects were non-significant when compared to active control groups.

Results from the largest randomized controlled trial to this date, MYRIAD, weakly support the benefits of universal MBIs. The MYRIAD randomized 84 secondary schools and 8,376 students aged 11 to 14, to either school-based mindfulness training condition or teaching as usual (Kuyken et al., 2022). Primary findings of the trial showed no superiority of mindfulness training over standard socio-emotional education on risk for depression, socio-emotional skills, and well-being at one-year follow up. Moreover, researchers (Montero-Marin et al., 2022) found that mindfulness training was associated with worse outcomes concerning depression risk and well-being for students already at risk of developing mental health impairment, although differences were not clinically significant. Secondary analyses, however, provided insightful evidence on feasibility factors. Montero-Marin et al. (2023) suggest that better mental health outcomes were reported in students who actually practiced mindfulness skills. This relationship seems to be moderated by the quality of delivery and the quantity of training sessions (Montero-Marin et al., 2023). Galla et al. (2023) further emphasized the importance of motivational factors and student engagement in the effectiveness of MBIs, suggesting that the effects are inseparable from engagement due to the nature of contemplative practices.

Fulambarkar et al. (2023) report that SBMIs significantly reduce adolescent stress but observed no effect on adolescent anxiety. Generally, stronger effects of MBIs have been reported when delivered to adolescents who already show elevated symptoms of poor mental health (Kallapiran et al. 2015).

The Learning to BREATHE (L2B; Broderick, 2013; Broderick & Frank, 2014) curriculum was selected as the relevant evidence-based mindfulness program for adolescents and therefore included in this research. The initial effectiveness trial on Learning to BREATHE

reported reductions in negative affect, and improvement in adolescents' emotion regulation (Broderick & Metz, 2009), alongside reductions of somatic stress manifestations. Further quasi-experimental evaluations of this program reported that the L2B program was beneficial in lowering perceived stress and psychosomatic symptoms, and in increasing emotional self-regulation (Metz et al., 2013). More recent evidence on L2B effectiveness confirmed the buffering effect of mindfulness on adolescent stress levels and depression symptoms (Lucas-Thompson et al., 2023). Taken together, these findings suggest that the Learning to BREATHE mindfulness curriculum produces beneficial, albeit small to moderate, effects on adolescent emotion regulation, subjective stress levels and other mental health outcomes.

Finally, the underlying mechanisms of MBIs should also be mentioned. Gu et al. (2015) provided a systematic review and meta-analysis of mediation studies on MBIs that encompassed both MBCT (Mindfulness-Based Cognitive Therapy) and MBSR (Mindfulness-Based Stress Reduction) programs. The authors found significant and strong effects for cognitive and emotional reactivity, and moderate to strong effects for rumination and worry as underlying mechanisms of MBIs. These findings suggest that mindfulness programs support changes in cognitive processing that contribute to intervention outcomes. Desrosiers et al. (2013) supported these findings and suggested that worry significantly mediated the path between mindfulness and anxiety, whereas rumination and reappraisal mediated the relationship between mindfulness and depression. This suggests that mindfulness operates through distinctive cognitive processes, such as non-reactivity and non-judgment, in reducing emotional reactivity and shifting the anxiety response (Desrosiers et al., 2013).

In conclusion, the presented evidence suggests that mindfulness-based programs have preventive potential for the adolescent population. However, the effectiveness of MBIs depends on various implementation factors, such as participant engagement, implementation quality and developmental appropriateness. While the presented mechanisms have been relatively well established in the adult population, further evidence is needed in understanding whether the same cognitive processes are hold in adolescence, when cognitive maturity is still developing.

1.3.4. Integrating mindfulness to stress-anxiety pathways

The chapters above gave an overview of mindfulness in relation to stress, anxiety, and mental health, while considering underlying cognitive processes. This chapter further integrates mindfulness within the theoretical model tested in this research. The empirical model positions

mindfulness in two roles within the stress-anxiety pathway and examines its possible dual role in the stress process.

Based on Kabat-Zinn's (1990) proposition that mindfulness deautomatizes habitual cognitive patterns of reactivity to stress, and considering Creswell and Lindsay's (2014) stress buffering account, this research argues that trait mindfulness moderates the relationship between objective stressors, or stressful life events, and subjective stress. Considering the appraisal logic from the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984), when an individual is faced with a stressful event, the appraisal of that event as threatening is shaped by their cognitive patterns and attention capacity. Here it is proposed that mindfulness influences this appraisal, by contributing to emotional regulation. Thus, mindfulness shapes attention capacity and shifts habitual appraisal patterns, toward more conscious appraisal, thereby regulating the stress response.

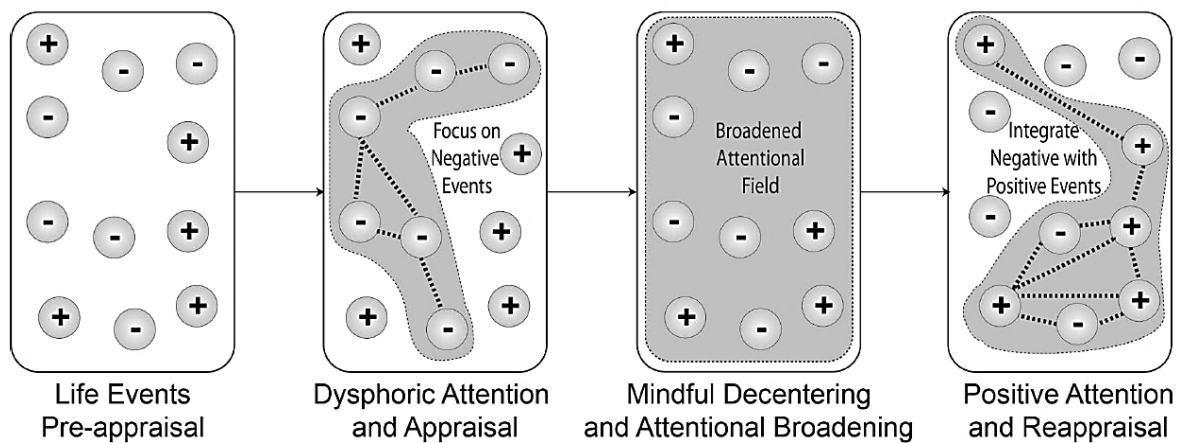
This mechanism is further elaborated in Garland's work. Garland (2007) first positioned mindfulness within the Transnational Model of Stress and Coping (Lazarus & Folkman, 1984) and proposed the Mindfulness Coping Model (Garland et al., 2009). This model followed a specific causality: when the event is appraised as threatening, mindfulness allows individuals to decenter from the stress appraisal, and shift into the metacognitive state of awareness. This state broadens attention capacity and allows for the positive reappraisal of the situation. The new appraisal then generates positive emotions that reduce psychological or subjective stress. This model (Figure 5) was later fully integrated into the Mindfulness-to-Meaning Theory (MMT; Garland et al., 2015a, 2015b). According to Garland et al. (2015b) mindfulness shifts habitual automatic processing and stress appraisal to metacognitive awareness through decentering. First, mindfulness interrupts the habitual automatic processing. Second, metacognitive awareness broadens the scope of attention, which allows for reappraisal of the situation by encompassing both positive and negative aspects of it. Consequently, through positive reappraisal, the events are reappraised as benign, meaningful, or growth-promoting. Finally, cumulative positive reappraisals further regulate attentional capacity toward more positive aspects, and when this process becomes self-reflexive, it implicates meaning even in the stressful circumstances (Garland et al., 2011, 2015b).

Garland et al. (2015b) suggested two central hypotheses in this theory. First, mindfulness reappraisal hypothesis suggests that mindfulness generates meaning by promoting positive reappraisal. Second, mindful savoring hypothesis proposes that mindfulness generates

meaning by enhancing attention capacity that accounts for positive experience. Finally, the authors suggest that mindfulness functions as a cognitive amplifier that strengthens attention control, interoceptive awareness, and psychological flexibility. In doing so, it contributes to emotion regulation capacity.

Figure 5

Stages of the Mindfulness-to-Meaning Theory as proposed in Garland et al. (2015b)



Note. Garland et al. (2015b) suggest that the reconfiguration process preserves primary appraisal, while the secondary appraisal reflects the immediate negative impact of the event.

The importance of the Mindfulness-to-Meaning Theory for the present dissertation lies in the understanding of mindfulness as a cognitive amplifier, thus allowing for the assumption of a dual role that is theoretically integrated within a single broader process model. However, both roles are grounded in the same underlying capacity of decentered awareness that manifests at different points in the stress-anxiety model. The moderating role intervenes in the stress sensitization pathway, thus changing the translation of stressful life events to subjective experience. The protective role accounts for both the appraisal stage (indirectly, by reducing subjective stress) and the level of anxiety symptoms (directly, by changing the underlying cognitions). Accordingly, the duality of mindfulness is proposed to reflect both the stress sensitization pathway and attenuate for the stress appraisal central to the Transactional Model of Stress and Coping.

1.4. Theoretical and empirical rationale of present research

The reviewed literature suggests that mindfulness, stress, and mental health are closely interrelated across adolescence. However, the aforementioned constructs are still more often examined only in part than within an integrated framework of adolescent mental health. This becomes particularly prominent when mental health is considered from a perspective of the dual continuum of mental health (Keyes, 2002). According to Keyes (2002), psychological distress and mental well-being represent related but not opposing dimensions of mental functioning. Although previous research has consistently linked stress (exposure) to poorer mental health outcomes, mindfulness has consistently been identified as an important protective factor (Dunning et al., 2019; Dunning et al., 2022) in this context. However, the comprehensive pattern of such interrelationships remains insufficiently clear. As a result, several important research gaps remain (Miles, 2017).

First, a theoretical and empirical gap exists in the limited number of studies that examine objective and subjective stress, mindfulness, and anxiety within one integrated framework. Although mindfulness has been repeatedly associated with lower levels of stress, better emotion regulation, and more adaptive mental health functioning in adolescents (Broderick & Metz, 2009; Metz et al., 2013; Pepping et al., 2016), its relationship within stress pathways is still insufficiently explored. Thus, a more integrated empirical approach is needed to determine whether mindfulness should be considered only as a distinct correlate of mental health or as a more active factor within the stress-anxiety pathway (Garland et al., 2015b).

Second, a methodological gap is present in the lack of longitudinal approaches that examine these associations over time. Cross-sectional studies are valuable for identifying concurrent relationships. However, they provide limited insight into temporal ordering and fail to account for prior levels of measured variables (Field et al., 2012). While such studies report moderate to strong correlations between stress and mental health outcomes (March-Llanes et al., 2017), longitudinal modeling provides more nuanced results that account for temporal stability and individual differences over time (Cole & Maxwell, 2003). This distinction is particularly important in adolescence, which is characterized by substantial individual change. Omitting the longitudinal perspective would make it difficult to determine whether associations between the observed constructs reflect developmental processes, or only short-term covariation (Rapee et al., 2019).

Another methodological issue concerns the conceptualization of stress, where distinctions between objective stress, typically operationalized as exposure, and psychological or subjective stress are inconsistent (Slavich, 2016). These conceptualizations are integral to understanding the specific stress processes within mental health research and may substantially shape the way that findings in this field are interpreted (Slavich, 2016).

The aforementioned gaps are especially relevant given the rise of internalizing difficulties during adolescence (Racine et al., 2021), when preventive actions are of particular importance. Understanding how protective factors, such as mindfulness, interact with stress exposure and appraisal, and identifying pathways through which risk and protective factors operate and are developmentally and accurately linked to later mental health outcomes, is necessary for evidence-based prevention actions.

1.4.1. Rationale for Study 1

The first part of the present dissertation was designed to address these gaps by examining the interrelationships between different stress conceptualizations, mindfulness, and adolescent anxiety. This was done by empirically testing the proposed model of associations between stress, mindfulness, and adolescent anxiety constructs using longitudinal data. This research focused on examining relationships beyond the cross-sectional perspective, and aimed to account for a more integrated perspective on how stress processes and mindfulness may be interrelated with anxiety over time. Particular emphasis was placed on stress operationalizations and accounting for two of the three established stress conceptualizations (Slavich, 2016). Thus, both objective and subjective operationalizations of stress were used, with the exposure count of stressful life events as a measure of objective stress (or stressors), and subjective stress levels as a measure of stress appraisal. This distinction allowed for an understanding of how individual experiences of stressful events translate to stress appraisal, and how such pathway later translates to mental health outcomes. At the same time, mindfulness was assigned a dual role within the stress-anxiety pathway: a moderator that buffers the sensitization mechanism, and a protective factor that lowers later anxiety both directly and indirectly through reducing subjective stress. These two roles correspond to different points in the stress process and reflect the postulates of the Mindfulness-to-Meaning Theory (Garland et al., 2015b). While components of the proposed model have been tested separately, the specific dual role of mindfulness in the stress process, where trait mindfulness simultaneously moderates the stress sensitization pathway, and contributes to later anxiety through subjective stress, has not been

tested in the adolescent population. Trait mindfulness has been found to moderate the effects of the life stressors on internalizing problems in adolescents (Cortazar et al., 2019; Lucas-Thompson et al., 2021). Simultaneously, mindfulness has been linked to lower stress and adolescent anxiety through the mediating effects of emotional regulation and negative cognitions (Desrosiers et al., 2013). However, no single model has examined the dual role of mindfulness in the stress – anxiety pathways, where mindfulness was integrated as (1) a moderator of the pathway from the objective to subjective stress, consistent with stress sensitization (Stroud, 2020), and Mindfulness Stress Buffering Account (Creswell & Lindsay, 2014), and (2) a protective factor with downstream effects to later adolescent anxiety, in accordance with Garland et al. (2015b).

Therefore, Study 1 addressed these gaps, and aimed to contribute to the understanding of developmental risk processes related to adolescent anxiety and stress vulnerability, as well as to identify protective processes relevant to adolescent mental health and prevention planning.

1.4.2. Rationale for Study 2

From a prevention perspective, it is important not only to fully understand the interrelationships between the examined constructs, in this case stress, mindfulness, and mental health problems, but also to examine whether such findings can be meaningfully and purposefully translated into preventive actions. Currently, mindfulness is the central focus of such initiatives and interventions.

Adolescence represents a particularly important developmental period for prevention, and the educational setting offers a feasible and accessible context for delivering universal mental health programs (Dunning et al., 2022). Accordingly, Study 2 focused on the effectiveness of a school-based mindfulness intervention in relation to stress and anxiety (which were central to Study 1), and to cognitive processes such as automatic thoughts. This underlying process that shapes how stress experiences are translated into anxiety (Beck, 1976) was introduced to further explore possible protective mechanisms of mindfulness (Garland et al., 2015b) that were not modeled in the longitudinal pathways. Therefore, the rationale behind Study 2 followed the claim that if mindfulness buffers the stress response and protects against the negative mental health outcomes, then an intervention including a mindfulness-based program should produce such effects. The Learning to BREATHE program (L2B; Broderick, 2013) was designed explicitly to teach the cognitive skills that the Mindfulness-to-Meaning Theory (Garland et al., 2015b) places at the center of its account: present-moment attention, decentering from thought and emotion, non-judgmental awareness, and the regulation of attention under affective load.

Furthermore, the concept of mental well-being was added in Study 2 to account for mental health evaluation beyond symptom-focused outcomes, and to align the intervention more clearly with Keyes' (2002) dual continuum of mental health. According to Keyes (2002), the presence of well-being is not reducible to the absence of mental illness. Accordingly, neither does the presence of mental health problems automatically diminish mental well-being. This broader outcome perspective was not possible to incorporate into Study 1 due to the study's embeddedness within a larger research project and was thus limited by the measures included in the study. Incorporating mental well-being in Study 2, addressed an empirical gap in the mindfulness literature, where evaluations of mindfulness-based interventions usually focus on distress and symptom reduction outcomes (e.g., stress, anxiety, and depression), rather than

overall mental health and well-being (Broderick & Metz, 2009; Dunning et al., 2019; Dunning et al., 2022; Metz et al., 2013).

Finally, Study 2 addressed a practical knowledge gap in the Croatian context. To date, there has been no reported research on the effectiveness of a mindfulness-based program for adolescents in Croatia. Also, there have been no known attempts to provide a systemic mindfulness intervention to the adolescent population, as a potential universal prevention strategy targeting mental health outcomes. The literature on mindfulness-based interventions in Croatia primarily presents theoretical overviews (Boričević Maršanić et al., 2015; Prijatelj et al., 2022), with no empirical findings. Therefore, Study 2 adapted the school-based mindfulness program Learning to BREATHE (Broderick & Frank, 2014), which has been shown to be developmentally appropriate for adolescents in promoting mental health and fostering well-being. The selection of the intervention program was made with regard to conceptual, developmental, and practical considerations. This program was chosen because it was specifically designed for delivery in the educational setting, making it suitable for school-based prevention (Broderick, 2013; Broderick & Frank, 2014). In addition to the program's developmental appropriateness, the selected program is grounded in mindfulness principles that are directly related to this dissertation, and closely concern stress regulation, emotional regulation, and cognitive reactivity (Broderick & Metz, 2009; Metz et al., 2013). Therefore, the Learning to BREATHE program was a suitable choice, which allowed us to examine both symptom-related outcomes of the intervention and the underlying mechanisms through which mindfulness may operate, including the deautomatization of automatic thoughts. Finally, the selection criteria included the program structure and the research-based framework of this specific program. These aspects allowed for the program to be adequately adapted to the Croatian school context without losing its core preventive focus.

2. RESEARCH AIM, PROBLEMS & HYPOTHESES

The general aim of this research is to explore the relationship between exposure to objective stressors and psychological or subjective stress, mindfulness, and anxiety among adolescents, and to examine the effect of mindfulness-based intervention on adolescents' perception of stress and mental health. To achieve this research aim, three specific research problems and related hypotheses were proposed as the following:

Research problem 1. Determine the interrelationships between mindfulness, psychological stress, and anxiety in a sample of Croatian adolescents.

Hypothesis 1. There is a statistically significant correlation between mindfulness, psychological stress, and anxiety in adolescents.

Hypothesis 1a. There is a statistically significant negative correlation between mindfulness and psychological stress among adolescents.

Hypothesis 1b. There is a statistically significant negative correlation between mindfulness and anxiety in adolescents.

Hypothesis 1c. There is a statistically significant positive correlation between psychological stress and anxiety in adolescents.

Research problem 2. Empirically test the assumed model of interrelationships among stress, mindfulness, and anxiety in adolescents.

Hypothesis 2. The model in which objective stress, mediated by psychological stress, contributes to anxiety, while mindfulness, through both mediation and moderation in the relationship between objective stressors and psychological stress, reduces it, will be acceptable based on model fit indices.

Hypothesis 2a. Objective stress significantly contributes to explaining anxiety both directly and indirectly through psychological stress.

Hypothesis 2b. Mindfulness significantly contributes to lower levels of psychological stress in the presence of objective stress.

Hypothesis 2c. Psychological stress significantly contributes to an increase in anxiety directly.

Hypothesis 2d. Mindfulness significantly contributes to reducing anxiety both directly and indirectly through psychological stress.

Research problem 3. Evaluate the effect of mindfulness-based intervention on the perception of stress and adolescent mental health.

Hypothesis 3. Levels of mindfulness, psychological stress, anxiety, mental well-being, and strength and belief in automatic thoughts significantly differ between the intervention and control groups after the intervention.

Hypothesis 3a. The level of mindfulness is significantly higher in the intervention group after the intervention compared to the control group.

Hypothesis 3b. The level of psychological stress is significantly lower in the intervention group after the intervention compared to the control group.

Hypothesis 3c. The level of anxiety is significantly lower in the intervention group after the intervention compared to the control group.

Hypothesis 3d. The level of mental well-being is significantly higher in the intervention group after the intervention compared to the control group.

Hypothesis 3e. The strength of belief in automatic thoughts is significantly lower in the intervention group after the intervention compared to the control group.

Hypothesis 3f. The frequency of automatic thoughts is significantly lower in the intervention group after the intervention compared to the control group.

3. METHODS

The overall study design of this doctoral dissertation consists of two complementary parts:

(1) *Longitudinal study*

(2) *Quasi-experimental effectiveness study*

The first part is a longitudinal study with two assessment timepoints, conducted in spring and autumn 2022. The second part is a quasi-experimental effectiveness study evaluating school-based mindfulness program, with three assessment points – pre-intervention, post-intervention (after 6 program sessions), and follow-up conducted approximately two months after post-intervention assessment. The overall effectiveness study was carried out between winter 2023 and spring 2024.

This doctoral research was embedded within a larger research project, the *Longitudinal Adolescent Stress Study (STRESS LOAD)* funded by the Croatian Science Foundation (project no. IP-2022-02-6925) and conducted at Institute of Social Sciences Ivo Pilar from March 2021 to February 2025. Longitudinal component encompassed in this thesis draws on the data collected from the first and second wave of the *STRESS LOAD* project, carried out from March 2022 to November 2022. The quasi-experimental effectiveness study represents a supplementary extension to the longitudinal perspective and was conducted from December 2023 to May 2024. Its primary aim was to examine feasibility and short- to medium-term effectiveness of a school-based mindfulness program, as well as to further explore possible underlying mindfulness mechanisms in adolescent mental health.

Due to differences in research designs between two studies, this chapter is organized by study first, with shared measures and analytic strategy presented altogether at the end of the chapter.

3.1. STUDY 1. Longitudinal study

3.1.1. Design and procedure

This study employed a two-wave longitudinal panel design, with assessments conducted in spring 2022 (T1) and autumn 2022 (T2), approximately 6 months apart, as part of the *STRESS LOAD* project. Data were collected in classroom settings using a mobile application designed for the project's purpose, with assessments supervised by researchers and psychology student assistants. Both assessment waves were scheduled outside of major exam periods and school holidays to minimize the influence exam period and academic stressors on student responses. All participants completed the same set of questionnaires at each measurement wave. Analyses were conducted on a sample of 1084 secondary school students who provided valid data at both study waves.

Prior to data collection, participants were informed about the research objectives. Informed consent was obtained from all participants, in person, with parental or guardian consent additionally obtained via email for students under 15 years of age.

3.1.2. Participants

Data were collected from high-school students attending 17 secondary schools in Zagreb as part of the *Longitudinal Adolescent Stress Study (STRESS LOAD project)*. To ensure sample representativeness with respect to socio-demographic characteristics, schools were selected using probabilistic cluster sampling from the broader list of secondary schools in Zagreb. The number of participating students varied across measurement waves, primarily due to school-level availability to participate in the study. Non-participation at the student level was minimal and largely attributable to illness-related school absence during the data collection periods. No formal inclusion or exclusion criteria were applied and participation was entirely voluntary for all students.

This doctoral thesis utilized data from the first and second wave of the *STRESS LOAD* project's data collection. Thus, baseline sample consisted of 1084 students who gave valid answers to both first- (T1) and second (T2) wave assessments. Out of 1084 students, 499 (46%) were male and 585 (54%) were female. The mean age of participants at baseline was 15.87 years ($SD = 0.76$), with ages ranging from 14 to 19 years. At the time of the first assessment (T1), 32.2% of students were enrolled in grammar schools, while 67.9% attended three- or four-

year vocational secondary schools. Regarding grade level, 45.6% of participants were first-year students and 54.4% were second-year students at T1 (spring 2022). Additional sample characteristics are shown in Table 1.

Table 1

Sample characteristics at baseline

Characteristic		<i>n</i>	<i>%</i>
High school type	Grammar school	229	36.8
	Vocational school (4-year)	581	67.9
	Vocational school (3-year)	46	5.4
Grade	First grade	390	45.6
	Second grade	466	54.4
Perceived family socioeconomic status	Below average	50	5.9
	Average	327	38.3
	Above average	476	55.8

Note. Total N = 1084; Percentages are valid responses; n=228 students did not provide valid responses regarding school type and grade, and n=231 students did not provide valid responses regarding perceived SES. SES was assessed using a single item measure of perceived family economic status and collapsed into below average (responses 1-2), average (value 3), and above average (values 4-5).

Although all participants completed the baseline assessment, the number of valid observations varied across measures. This pattern reflected incomplete questionnaire completion rather than item-level missing data as some students completed earlier sections of the survey, but did not proceed to full questionnaire completion.

3.1.3. Ethical considerations

The study protocol was reviewed and approved by the Ethical Committee of the Institute of Social Sciences Ivo Pilar (no.11-73/20-479) and the Ministry of Science and Education for conducting the study in a school setting. Additionally, this doctoral research received the

necessary approval from the Ethical Committee of the Faculty of Education and Rehabilitation Sciences, University of Zagreb.

Written informed consent was obtained from all participants prior to data collection. Additionally, for students under the age of 15, parental or legal guardian consent was also obtained via email, in accordance with the relevant ethics code. Participants were informed about the general research focus, voluntary nature of their participation and the possibility to withdraw from the study at any time without consequences. Students were also informed that their responses would be treated confidentially. Given the adolescent population, and considering the research topic, additional care was taken to ensure that the assessment procedures posed minimal risk to participants. Thus, data collection was conducted in classroom settings under researcher's supervision, allowing participants to ask questions or discontinue participation if they experienced discomfort. Information on available school-based or external support resources was provided when appropriate.

STUDY 2. Quasi-experimental effectiveness study

3.2.1. Design and procedure

The study employed a quasi-experimental, non-equivalent control group design with three measurement points and assignment at the school level. Two language-oriented grammar schools participated in the study, with one school assigned to the intervention condition and the other serving as a comparison control. Assignments occurred at the school level due to practical and administrative constraints and did not involve randomization of individual students. School-level assignment was also chosen to minimize the risk of treatment diffusion, or informal information transfer or shared experiences between students in different conditions. This is a known threat to internal validity in classroom-based intervention research, where students in different conditions attend the same school (Field, 2018).

Schools included in the effectiveness study were selected out of a larger pool of secondary schools that had previously participated in the longitudinal part of the *STRESS LOAD* project. Two schools were selected based on their availability and school's readiness to participate in the intervention study. While selecting the schools, attention was paid to matching two schools according to the student profile (gender and grade point average - GPA) and dominant school type and educational orientation (e.g. mathematics-focused, language-

focused, or general grammar school programs). The allocation to the intervention and control conditions was determined at the school level, considering the school readiness and organizational feasibility. The study was conducted in coordination with school psychologists and administrative staff.

The intervention was delivered at the school level following completion of the baseline assessments. All participating students within the intervention school were offered the program, while the control school continued with the standard curriculum. No additional mindfulness or stress-reduction interventions were delivered concurrently in either school within the study period.

Data collection took place at three time-points: at baseline (pre-intervention; T1), post-intervention, or immediately following the intervention (T2), and at a three-month follow-up (T3). All three assessment waves (baseline, post-intervention, and follow-up) were scheduled outside of major exam periods to minimize the influence of academic stressors on student responses. All students completed identical set of questionnaires at each measurement wave. Additionally, intervention group participants completed the qualitative set of questions regarding their experience participating in the program. Detailed overview of all measures is provided in section 3.4. *Measures*.

3.2.2. *Participants*

A total of 237 third-grade secondary school students, enrolled in two language-oriented grammar schools in the Zagreb area participated in the quasi-experimental effectiveness study. The third-grade students enrolled at the time of the effectiveness study had been first- and second-grade students during the longitudinal data collection in spring and autumn 2022, thus representing the same school-level cohort across both studies. Although the initial study design aimed to assess the entire generation of eligible students within each school, the number of participants differed between groups (control versus intervention) and across measurement waves due to student absence during data collection and incomplete questionnaire response. Both control and intervention groups are of comparable sizes and initially tested of nearly equal numbers of participants.

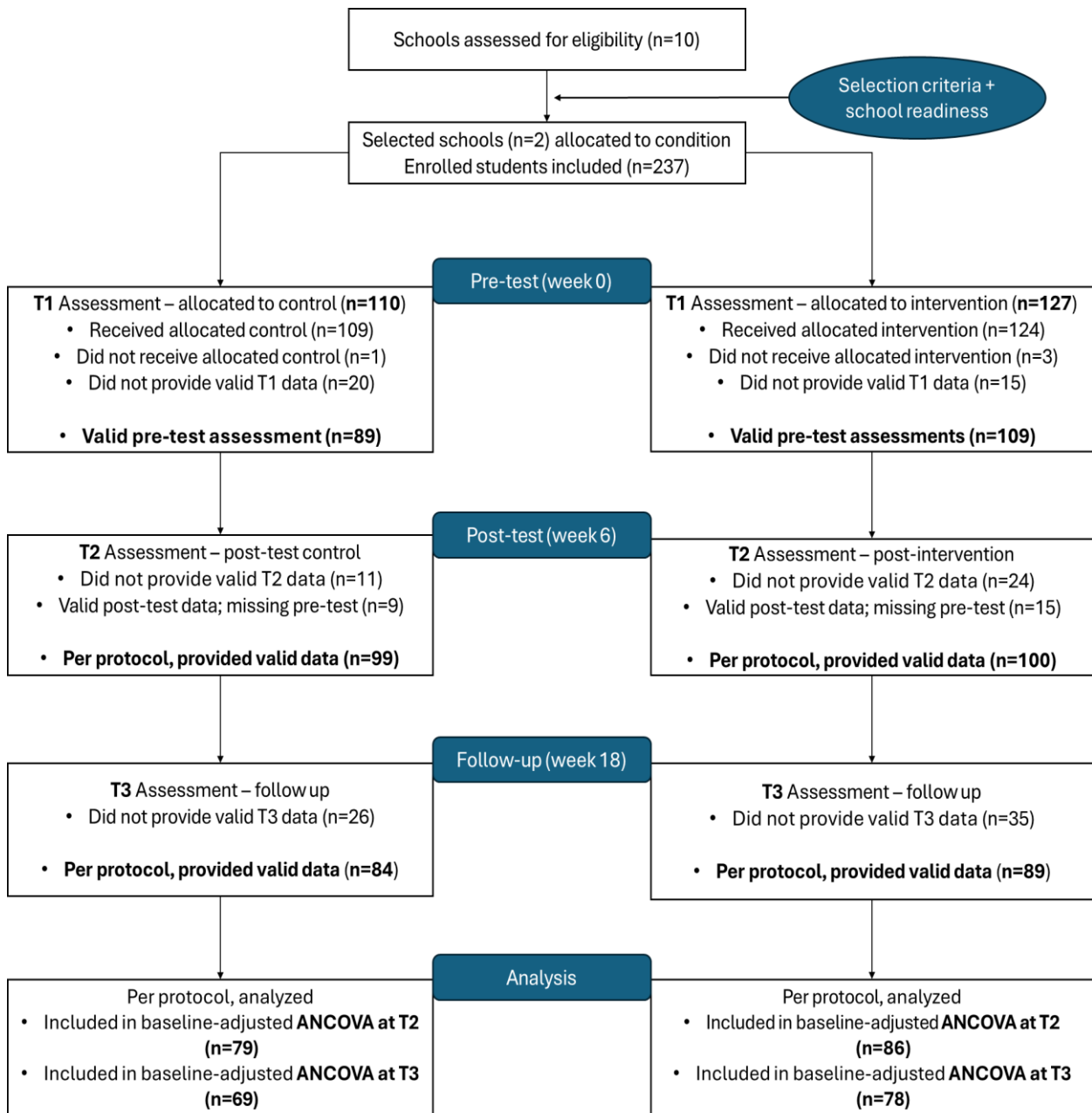
Sample size was determined a priori using power analysis for between-group comparison with one covariate, assuming a medium effect size ($f = 0.25$), $\alpha = .05$, and power of .80, which indicated a minimum of 84 participants. This estimate was increased by 30% to

account for expected attrition, resulting in a target sample of 109 participants. The achieved samples at baseline ($N = 198$), post-intervention ($N = 165$), and follow-up ($N = 147$) exceeded this target across all measurement waves.

Of total 233 participating students, 198 students completed the baseline assessment (T1), 199 participated in the post-intervention assessment (T2), and 173 students participated in the follow-up measurement (T3), conducted three months after the post-test assessment. Excluded from the analyses were any participants that had full missing data in any assessment wave. Detailed overview of the sampling protocol is shown in Figure 6.

Figure 6

Sampling protocol flow diagram of the mindfulness-based intervention study



Note. Number of participants who provided data at each wave are noted, regardless of participation at other wave; Wave-specific participation counts are reported rather than cumulative attrition only.

Of total 233 students who had participated in the study, majority (76.4%) were female adolescents ($n_{\text{control}}=89$, $n_{\text{intervention}}=89$), while 23.6% were male ($n_{\text{control}}=20$, $n_{\text{intervention}}=35$). Average age of the participants was 16.77 years ($SD = 0.45$). The observed gender distribution in the sample reflects the fact that both participating schools included were language-oriented grammar schools, which are typically attended by a higher proportion of female students.

Prior experience with mindfulness or meditation practices was assessed to account baseline exposure relevant to the intervention. In addition, students reported on current mental health difficulties and involvement in psychological counselling or treatment. Detailed information by group is presented in Table 2. Across both groups, the relative majority of students reported no current mental health difficulties. Engagement in psychological treatment or counselling was reported by around 13% of students in each group, and only a small subset of those students reported prior exposure with mindfulness techniques through ongoing psychological support. Overall, reported characteristics suggest limited prior familiarity with mindfulness practices, providing important context for the interpretation of intervention effects.

Table 2

Mental-health related baseline characteristics of participating students by group

		Group	
		Intervention (<i>n</i> , %)	Control (<i>n</i> , %)
Current mental health difficulties	Yes	48 (44%)	32 (36%)
	No	45 (41.3%)	37 (41.5%)
	Not sure	16 (14.7%)	20 (22.5%)
Currently in treatment/counselling	Yes	14 (12.8%)	12 (13.3%)
	No	93 (85.3%)	78 (86.7%)
	Not sure	1 (0.9%)	0
	School psychologist support	1 (0.9%)	0
Mindfulness techniques used in treatment	Not applicable	92 (84.4%)	77 (86.5%)
	Yes	6 (5.5%)	4 (4.5%)
	No	11 (10.1%)	9 (10%)

Note. ‘Not applicable’ category was offered as alternative for students avoiding to provide exact answer to above measures; Presented characteristics were measured at baseline, thus percentages are calculated in relation to group total baseline sample ($n_{\text{intervention}}=109$, $n_{\text{control}}=89$).

Students reporting active ongoing engagement in formal mindfulness practice or severe mental health difficulties accompanied by ongoing treatment were excluded from participating in the intervention, although such were small in number (n=3) (Figure 6). Similarly, a small number of students in the control group (n=1) (Figure 6) who reported receiving external psychological support explicitly involving mindfulness practices were excluded from future analyses.

3.2.3. Intervention and Control conditions

Intervention condition

Participants in the intervention condition received a school-based mindfulness program adapted from the *Learning to BREATHE* (L2B) curriculum (Broderick, 2013; Broderick & Frank, 2014). The program is grounded in mindfulness-based approaches to enhance present-moment awareness, emotional awareness, attentional regulation and adaptive responses to stress.

Program delivery. The intervention was delivered over six consecutive weeks, with one session per week conducted during usual school hours. Each session lasted approximately 40 minutes and was facilitated by a trained instructor with experience in mindfulness-based practices and work with adolescents. Sessions followed a standardized delivery plan to ensure consistency across groups.

Program adaptations. The adapted program retained the core theoretical framework and learning objectives of the original L2B short curriculum version, which integrates mindfulness practices targeting body awareness, attention regulation, emotional awareness, and adaptive responses to stress. Each program session included brief psychoeducational components, guided mindfulness exercises, and opportunities for reflection and group discussion.

To support personal mindfulness practice between sessions, students were provided with audio (or visual; depending on session) material corresponding to the mindfulness practices introduced in each session. Participants were encouraged to use these materials independently between sessions, and to continue practicing after program completion, especially during the period between post-intervention and follow-up assessments.

Finally, adaptations to the original Learning to BREATHE curriculum were made to accommodate Croatian school context and scheduling constraints (cultural and contextual adaptations). These adaptations included a shortened six-week format, with adjustments made only in terms to the length and pacing of sessions, ensuring no core mechanisms or practices are changed. Thus, individual exercises and practices included in the delivery plan were attentively selected to preserve the essential context and pedagogical approach of the L2B program, without introducing substantial changes to its core theoretical foundations. Finally, all six program lessons were adapted, and implemented as following topics: (1) *My Body*, (2) *My Mind*, (3) *My Emotions*, (4) *My Attention/Focus*, (5) *Relationships with (close) others*, (6) *My Good Habits*.

The curriculum was translated in Croatian and reviewed for cultural appropriateness, by a team from a Laboratory for Prevention from the University of Zagreb Faculty of Education and Rehabilitation Sciences, with additional attention to language use and presentation of mindfulness practices as an evidence-based mental health promotion approach.

Control condition

Participants in the control condition attended a comparison school and did not receive any mindfulness-based program during the study period. The control school continued with the standard education curriculum and routine activities as usual. No structured activities targeting mindfulness, stress management, or emotional regulation were introduced during the study timeframe.

3.2.4. Ethical considerations

The study protocol was reviewed and approved by Ethical Committee of the University of Zagreb Faculty of Education and Rehabilitation Sciences as well as the Croatian Ministry of Science and Education which granted permission to conduct the study in the school setting. Prior to beginning of the study, school principals (acting as institutional gatekeepers), were informed in detail about the study aims, research protocol and implementation requirements. Thus, principals played the key role in final stage of the school selection process, by confirming school readiness for participation and facilitating program implementation.

Prior to participation, students were informed about the general research focus and procedures. Written informed consent was obtained from participating students. Parents or legal guardians were informed about the study through the school administration as part of the

school's regular prevention activities. Only upon parental request, students could be excluded from participating in the program, which only insignificant number of parents opted for (n=2). Thus, these exclusions did not affect study procedure.

Participants were informed that their participation was voluntary and that they could withdraw from the study at any time. Although the program was delivered at the class level as part of the school-based prevention activities, students retained the right to decline participation in data collection. Finally, participants were informed that all responses would be treated confidentially. To preserve participants' anonymity, no identifying information was collected. Instead, participants generated their own six-digit alphanumeric code at each assessment wave, following standardized rules (e.g., first letter of mother's name, last digit of personal phone number), which allowed responses to be matched across measurement waves while keeping participants' identity unknown. Data collection was conducted in classroom settings under researcher's supervision, allowing participants to ask questions and ensuring minimal risk or discomfort. The study procedures were designed in accordance with ethical principles for research involving minors and adhered to the Declaration of Helsinki.

3.4. Measures

Primary outcomes encompassed in both research studies largely overlapped, and had included measures of mindfulness, subjective stress, anxiety, mental health and automatic thoughts. The questionnaires used during the longitudinal study (Study 1) and quasi-experimental effectiveness study (Study 2) are identical, with the battery of the quasi-experimental study additionally including the Warwick-Edinburgh Mental Well-being Scale, Automatic Thoughts Questionnaire, and items related to participants' motivation and program evaluation.

The questionnaire battery, along with the sociodemographic data questionnaire (age, gender, socio-economic status, academic achievement, school type), included the following scales:

- CAMM – *Child and Adolescent Mindfulness Measure* (Greco et al., 2011)
- PQ – *The Problem Questionnaire for Adolescents* (adapted from Seiffge-Krenke, 1995; Milas et al., 2019)
- AISLE – *The Adolescent Inventory of Stressful Life Events* (Milas et al., 2023)
- GAD-7 – *Generalized Anxiety Disorder 7-item Scale* (Spitzer et al., 2006)
- WEMWBS – *Warwick-Edinburgh Mental Well-being scale* (Tennant et al., 2007)³
- ATQ – *Automatic Thoughts Questionnaire, adapted form* (Netemeyer et al., 2002)⁴

³

⁴ Additional questionnaires included in the quasi-experimental study

3.4.1. General and sociodemographic data questionnaire

Each questionnaire battery began with a brief sociodemographic section. In the longitudinal Study 1, this included gender (male / female), age (calculated from reported month and year of birth), school type (grammar school, four-year vocational, three-year vocational), grade level (first or second), and perceived family socioeconomic status. Perceived SES was assessed using a single-item measure rated on a 5-point scale (1 = much worse than most other families, 5 = much better than most other families), and collapsed into three categories for analysis (below average, average, above average), as shown in Table 1.

In Study 2, the sociodemographic section included gender (male / female), age (from month and year of birth), household size, parental education for mother and father separately (1 = primary school or less, 2 = two- or three-year secondary school, 3 = four-year secondary school, 4 = university or higher education, 5 = doctorate), school attended, grade level, and grade-point average from the previous academic year on the Croatian 1-5 scale. Prior experience with meditation or mindfulness practices was assessed at baseline using a single dichotomous item, and current mental health difficulties as well as engagement in psychological treatment were assessed using three-level items (yes / no / not sure), as shown in Table 2.

In addition to the sociodemographic items, the Study 2 questionnaire included items assessing student motivation, pre-intervention expectations regarding mindfulness practice, and participation experience at post-intervention and follow-up. Motivation and expectation items were administered at baseline (T1) on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Participation experience items administered at post-intervention (T2) and follow-up (T3) included perceived usefulness of mindfulness techniques, ease of participation in the program, frequency of individual mindfulness practice between sessions, type of practices used, and willingness to recommend the program. Open-ended items at T2 and T3 invited students to describe their experience of participation, including any difficulties encountered during participation in the program, and any noticed changes in daily functioning. Full item content of questionnaires is provided in Appendix (Supplementary Materials 1, 2, and 3).

3.4.2. Mindfulness

Two measures of mindfulness have been used across studies. Trait mindfulness was assessed using both the CAMM and the MAAS-A. However, CAMM was used as primary

measure of adolescent mindfulness scores due to it being more appropriate regarding the sample characteristics.

Greco et al. (2011) *Child and Adolescence Mindfulness Measure (CAMM)* contains 10 items describing ways of thinking, behaving, and feeling that encompass qualities of mindfulness (e.g. *It's hard for me to pay attention to only one thing at a time.*). Participants assess the truthfulness of each statement on a scale from 0 ("almost never true") to 4 ("almost always true"). The total score was computed as the mean of all 10 items, with theoretical score range from 0 to 4. Higher mean score indicates higher levels of trait mindfulness. The internal consistency reliability of the scale using Cronbach alpha at each wave of the longitudinal study, in the sample of Croatian adolescents, amounts to $\alpha = .86$, and $\alpha = .87$.

Although an additional mindfulness measure, *Mindful Attention Awareness Scale for Adolescents (MAAS-A; Brown et al., 2011)*, was included in both studies as a secondary mindfulness measure, all analyses concerning research problems two and three, and within the framework of this doctoral research, includes CAMM as the primary adolescent mindfulness measure. The MAAS-A scale consists of 14 items rated on a 6-point scale (1 = almost always to 6 = almost never), with the total score computed as the mean of all items, and higher mean scores indicating higher levels of trait mindfulness. The decision to use CAMM as the primary measure of trait mindfulness in this doctoral research, was based on the methodological aspects of two measures, where CAMM was initially developed as a developmentally appropriate measure of adolescent mindfulness, whereas MAAS-A was merely adapted instrument commonly used for assessments on general population. Secondly, CAMM was included in the obligatory part of the questionnaire of the longitudinal study, meaning that all participants have fulfilled the assessments, while MAAS-A was encompassed in the non-obligatory assessment, meaning that only students who wanted to participate made the assessments. Thus, the number of participants was unequal regarding two measures. MAAS-A data were therefore not included in the main analyses.

3.4.3. Subjective (or psychological) stress

To assess perceived, or psychological stress, short version of *The Problem Questionnaire for Adolescents (PQ)* (adapted from Seiffge-Krenke, 1995; Milas et al., 2019) was included in both studies. The scale consists of 18 items (e.g. *My parents show little understanding for my problems in school.*) describing problems within specific areas of everyday functioning. Participants assess the degree to which each problem is stressful on a

scale from 1 ("not stressful") to 5 ("extremely stressful"). Subjective stress was measured as a mean total of all 18 items that reflected the six following subscales: (1) *School problems*, (2) *Future-oriented stress*, (3) *Parents-related stress*, (4) *Friends-related stress*, (5) *Relationship problems* and (6) *Self-related stress*. Total score was computed as mean of all items, with theoretical range from 1 to 5. Higher scores indicate higher levels of subjective stress. The total score was used as a global indicator of subjective stress across multiple domains of adolescent everyday functioning, consistent with prior applications of the instrument (Seiffge-Krenke, 1995; Milas et al., 2019). The internal consistency of the total scale in the sample of Croatian adolescents was assessed using Cronbach's alpha coefficient for each wave and is $\alpha = .92$, $\alpha = .92$.

3.4.4. *Objective stress (stressful life events as stressor exposure)*

The Adolescent Inventory of Stressful Life Events (AISLE) (Milas et al., 2023) was used as a measure of objective stressors or cumulative stress exposure. Stressor exposure was operationalized as the number of stressful life events experienced during the past year. The scale contains a list of 49 stressful life situations (e.g. *Health problems of a close person: Serious illness or physical injury of a parent or guardian*), and participants are required to indicate for each statement whether they have experienced it within the last year (0 = "not experienced", 1 = "experienced") and then assess how stressful it was for them on a scale from 1 ("not at all stressful") to 5 ("extremely stressful"). Objective stressors were operationalized using a cumulative stressful life events exposure score (count only), reflecting the number of events experienced at baseline. In accordance with previous research regards to methodological aspects of this variable in wider stress research, both experience count and severity index reflecting the mean perceived impact of experienced events (with non-experienced events coded as zero) were computed. However, primary analyses centered around cumulative stress exposure, thus only experience count of stressful life events was taken into analyses examining model testing. Participants who did not complete the stressful life events questionnaire were treated as missing on these measures. Total count score is computed as the sum of all items, with scale range 0 to 49. High internal consistency is not expected for most of the AISLE stress domains. Thus, the coefficient of internal consistency does not appropriately reflect such estimate, and was not calculated for this scale.

3.4.5. Anxiety severity

Generalized Anxiety Disorder 7-item Scale (GAD-7) (Spitzer et al., 2006) was used to assess generalized anxiety severity. The scale consists of 7 statements (e.g. *Feeling nervous, anxious, or on edge*) for which participants rate on a scale from 0 ("not at all") to 3 ("nearly every day") how much each problem has interfered with their daily functioning in the past two weeks. Total score was computed as the mean of all items, with theoretical range from 0 to 3. Higher scores indicate higher levels of anxiety. The internal consistency reliability of the scale in the sample of Croatian adolescents measured as Cronbach alpha coefficient amounts $\alpha = .89$ for each wave.

3.4.6. Mental Well-being

Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007) was used to assess adolescent mental well-being. The questionnaire consists of 14 items (e.g. *I've been thinking clearly.*) that measure the extent to which participants have experienced the feelings and thoughts described in the past two weeks. Participants record their responses on a five-point scale, where 1 indicates "never" and 5 indicates "all the time". Total score was computed as the mean of all items, with theoretical range from 1 to 5. Higher scores indicate higher mental well-being. The internal consistency reliability of the scale in the sample of Croatian adolescents is $\alpha = .89$.

3.4.7. Automatic thoughts - frequency and belief

Adapted version of *Automatic Thoughts Questionnaire* (Netemeyer et al., 2002), encompassing both frequency and belief in automatic thoughts was included as a measure of severity and belief in automatic thoughts. The revised ATQ form questionnaire consists of 15 items (e.g. *Something has to change.*) and measures the strength of belief in specific automatic thoughts on a scale from 1 ("not at all") to 5 ("completely"). An adapted version of the revised ATQ questionnaire was used in the quasi-experimental study, thus incorporating a measure of the frequency of occurrence of each thought in the past week on a scale from 1 ("never") to 5 ("always"), following the original and Croatian versions of the questionnaire (Proroković & Vulić-Prtorić, 2004). Total scores were computed as the mean of all items, respectively for frequency of the automatic thoughts and the belief in the automatic thoughts. Theoretical range of the scale is from 1 to 5. Higher scores indicate more frequent occurrence of automatic thoughts and reflect stronger beliefs in automatic thoughts. Internal consistency using

Cronbach's alpha coefficient for both frequency and belief subscales was $\alpha = 0.95$, $\alpha = 0.94$, respectively.

3.5. Analytic strategy

The analytic strategy is presented separately for Study 1 and Study 2, to reflect differences in research design and analytic approach. Therefore, the following sections are organized by study first and research problem second.

STUDY 1. Longitudinal study

Analyses for Study 1 were conducted to address two research problems: (1) to examine the interrelationships between mindfulness, stress and anxiety in the sample of Croatian adolescents, and (2) to empirically test the hypothesized model of relationships among the stated constructs. Analyses were conducted using the IBM SPSS Statistics (version 27.0), and R version 4.3.2. (R core team, 2022). All analyses included participants with valid data at both T1 and T2 measurements.

3.5.1. Analyses related to the Research problem 1

To address the hypotheses related to the first research problem, bivariate associations among mindfulness, psychological stress, and anxiety were examined to separately at each wave (baseline [T1] and follow-up [T2]). In addition, stability correlations between baseline (T1) and follow-up (T2) were calculated for each construct to examine temporal stability over the six-month period. Effect sizes were reported as Pearson correlation coefficients (r). Any missing values within the analyzed variables were handled using pairwise deletion, which is standard for correlational analyses.

3.5.2. Analyses related to the Research problem 2

To address the hypotheses related to the second research problem, the hypothesized relationships among the study variables were tested within the structural equation modelling (SEM) framework with manifest variables (i.e., mean total scores). This approach, commonly used in applied adolescent research, was selected due to its relative simplicity and interpretability when working with manifest variables, and because it facilitates model replication without introducing unnecessary model complexity. The model examined the associations among stress, mindfulness, and anxiety in adolescents, including the hypothesized moderation and mediation pathways. First, the contribution of objective stressors to later anxiety was examined. Both the direct effect of objective stressors on later anxiety and the indirect effect through subjective stress as a mediator were tested. Second, the moderating role

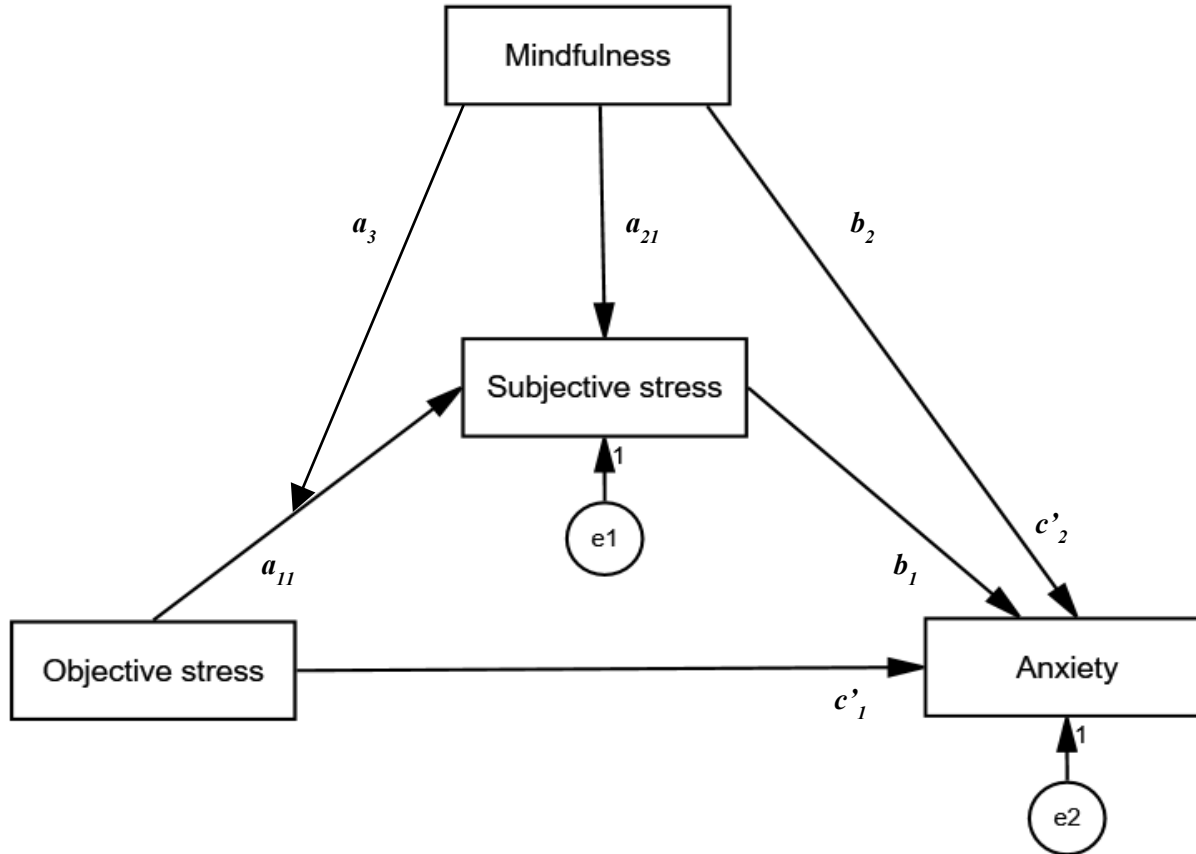
of mindfulness in the association between the objective stressors (stressful life events) and subjective stress was tested. To test the moderation component, predictor variables were mean centered and an interaction term between objective stressors and mindfulness was computed. Finally, the contributing role of mindfulness to later anxiety was examined through both direct and indirect effects with subjective stress as a mediator. The conceptual model is presented in Figure 7.

Preliminary, descriptive and correlational analyses were conducted using the IBM SPSS Statistics (version 27.0) software. Preliminary SEM analyses with manifest variables were estimated in IBM SPSS Amos (version 27.0), and the final SEM analyses with manifest variables were conducted in R 4.3.2. (R core team, 2022) using {lavaan} package (Rosseel, 2012). Any missing values within the analyzed variables were handled using full information maximum likelihood (FIML) estimation (Kline, 2023). This common SEM method for handling missing data allows parameter estimates and standard errors to be calculated using all available data. Direct effects were reported as unstandardized regression coefficients (b) with standard errors (SE), standardized coefficients (β), p values, and 95% bootstrap confidence intervals based on 5,000 resamples. Indirect effects were reported as unstandardized coefficients (b) with 95% bootstrap confidence intervals based on 5,000 resamples and were considered statistically significant when the confidence interval did not include zero. Model fit was evaluated using standard SEM fit indices: χ^2 , CFI, TLI, RMSEA with 90% confidence interval, and SRMR). Acceptable model fit was indicated by CFI and TLI values equal or above .95 ($\geq .95$), RMSEA $\leq .06$, and SRMR $\leq .08$, in accordance with Hu & Bentler (1999). The χ^2 statistic is reported and interpreted in relevance to the sample size, following Kline's (2023) suggestion that of cutoff point equal or below 3 indicated good model fit.

In addition to the primary model, an alternative model with autoregressive path was tested in which baseline anxiety was included as predictor of later anxiety.

Figure 7

Conceptual model of mindfulness, stress and adolescent anxiety



Note. Objective stress = a cumulative stressful life events exposure; Subjective stress = stress appraisal; Anxiety = anxiety symptoms; Mindfulness = trait mindfulness. a-paths (a_{11} , a_{21} , a_3) represent effects on subjective stress; b-paths (b_1 , b_2) represent effects on anxiety; c'-paths (c'_1 , c'_2) represent direct effects on anxiety; e_1 and e_2 denote residual variances.

STUDY 2: Quasi-experimental effectiveness study

3.5.3. Analyses related to the Research problem 3

The effectiveness study was analyzed in several steps. First, descriptive statistics were calculated for all variables at each time point. Preliminary analyses were conducted to assess the assumptions relevant to ANCOVA. Given the non-randomized design and the possibility for baseline differences between groups, group differences at post-intervention and follow-up were examined using analyses of covariance (ANCOVA) to examine the intervention effects. This approach was selected over the mixed-design analysis of variance as more appropriate for quasi-experimental designs with non-equivalent groups, since ANCOVA adjusts post-intervention outcomes for pre-existing differences on the dependent variable and provides greater statistical power for detecting intervention effects (O'Connell et al., 2017; Vickers & Altman, 2001). Separate ANCOVA models were estimated for each outcome for post-intervention (T2) and follow-up (T3) outcomes, with group (intervention vs. control) specified as the between-subjects factor and baseline (T1) scores entered as covariates. This analytic approach allowed for the estimation of adjusted group differences at each post-baseline time point while accounting for pre-existing differences between schools.

Prior to conducting ANCOVA, key assumptions were examined, including homogeneity of variances, linearity of the relationship between the covariate and the outcome, and homogeneity of regression slopes. When the assumption of the homogeneity of regression slopes was met, standard ANCOVA models were estimated. When this assumption was violated, the baseline x group interaction term was retained in the model and results were interpreted conditionally. Missing data were handled using default IBM SPSS listwise deletion within each ANCOVA model. Accordingly, analyses were conducted using available data for each outcome, with participants who had completely missing data at a given assessment wave excluded from that analysis. All statistical analyses were conducted using IBM SPSS Statistics (version 27.0), with statistical significance evaluated at $p < .05$. Effect sizes were reported as partial eta squared (η^2_p). Each of the six outcomes was specified a priori as a primary outcome corresponding to a separate research hypothesis tied to a distinct construct, as detailed in the approved research proposal. As the outcomes assess conceptually distinct constructs rather than a single underlying construct, no family-wise correction across the six outcomes within an assessment wave was applied, and multivariate approaches (e.g., MANCOVA) were not used. Each ANCOVA was evaluated at $\alpha = .05$. Within each ANCOVA model, pairwise comparisons

between the intervention and control group used the Bonferroni adjustment available in the SPSS GLM procedure.

Results were interpreted as evidence of intervention-related differences in post-intervention (T2) and follow-up (T3) outcomes, consistent with program effectiveness within the participating schools, rather than as definitive causal effects and not generalizable findings beyond this study context.

4. RESULTS

Results are structured by study first, and by research problem second.

STUDY 1. Longitudinal study – Research problems 1 and 2

4.1. Longitudinal study: Descriptive statistics

Descriptive statistics for all longitudinal study variables at baseline (T1) and follow up (T2) are presented in Table 3. Due to occasional missing responses across measures and assessment waves, the number of observations varied between variables. Therefore, correlational analyses were conducted using pairwise deletion, with each correlation based on all available data for the respective pair.

At baseline, adolescents reported average levels of trait mindfulness, alongside average levels of both subjective stress and anxiety. Subjective stress was assessed as an overall construct, and was only descriptively inspected across specific domains (shown in supplementary Appendix Table 1a), including school-related stress, future-oriented stress, parental, peer, relationships and self-related stress. This pattern was replicated in the second wave, suggesting that future-related stress remained adolescents' most salient source of stress across time. Other than future-related stress, stress related to self-perception, in terms of both personality and physical appearance, is reported second most salient stress domain across study waves. Lastly, stress regard to intimate and close relationships is reported least prominent source of stress for adolescents in our sample across all measuring waves. At the follow-up assessment, mean levels of mindfulness, stress, and anxiety were largely comparable to baseline values, with some variation in dispersion across variables. Stressful life events were assessed at baseline only. Mean levels of stress associated with stressful life events were relatively low, with substantial variability across participants, consistent with the expected distribution of such events in adolescent community sample.

Inspection of distributional properties of measured variables, including skewness, kurtosis, and histogram plots, indicated that most variables approximated normal distributions, supporting use of parametric analyses.

Table 3*Descriptive statistics of variables included in the longitudinal study*

		<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>IS</i>	<i>IK</i>	<i>Valid n</i>	<i>Reliability (α)</i>
Mindfulness	CAMM wave 1	2.24	0.83	0	4	0.03	-0.6	856	.86
	CAMM wave 2	2.22	0.83	0	4	0.05	-0.43	922	.87
Objective stress	SLEs exposure count wave 1	13.03	7.58	0	46	1.24	1.74	722	N/A
Subjective stress	Subjective stress wave 1	2.23	0.83	1	5	0.59	-0.42	855	.92
	Subjective stress wave 2	2.31	0.83	1	5	0.39	-0.47	923	.92
Anxiety	GAD wave 1	1.07	0.78	0	3	0.57	-0.54	855	.89
	GAD wave 2	0.95	0.76	0	3	0.72	-0.19	923	.89

Note. IS = skewness; IK = kurtosis; Objective stress was measured at baseline (T1) only; Reliability for SLE exposure count is not calculated while separate stressful life events are not necessarily expected to be intercorrelated

4.2. Research problem 1: Interrelationships between mindfulness, psychological stress, and anxiety

To test the first research problem and subsequent hypotheses, bivariate correlations were conducted for all study variables, thus examining both within- and between-wave associations between variables.

The pattern of intercorrelations among selected variables was highly consistent across both measurement points. Baseline and follow up correlations among mindfulness, subjective stress and anxiety are presented in Table 4. Higher levels of mindfulness were consistently associated with lower levels of stress and anxiety, with stronger associations for CAMM than for the MAAS-A ($r1_{MAAS-A - subjective\ stress} = -.56; p < .001$; $r1_{MAAS-A - anxiety} = -.60; p < .001$; $r2_{MAAS-A - subjective\ stress} = -.56; p < .001$; $r2_{MAAS-A - anxiety} = -.61; p < .001$) thus supporting the use of CAMM as the primary measure of adolescent mindfulness in subsequent analyses. Higher levels of mindfulness as measured with CAMM were consistently significantly associated with lower levels of adolescents' subjective stress at both baseline ($r = -.66; p < .001$), and six-month follow up measurement ($r = -.65; p < .001$). As expected, same negative correlational pattern is seen between mindfulness (as measured with CAMM) and adolescent anxiety, where higher levels of mindfulness are significantly negatively associated with adolescent anxiety across time ($r = -.68, r = -.63; p < .001$). The correlations pattern among mindfulness, stress and anxiety was strong and highly temporally consistent. Subjective stress and anxiety were, in turn, significantly and strongly positively correlated in both time points ($r = .66, r = .58; p < .001$). Overall, the pattern of intercorrelations was consistent with theoretical models conceptualizing mindfulness as a protective factor in the relationship between stress and anxiety.

Table 4*Intercorrelations among mindfulness, subjective stress and anxiety at baseline and follow-up*

Variable	1	2	3
1. Mindfulness (CAMM)	—	-.65***	-.63***
2. Subjective stress	-.66***	—	-.58***
3. Anxiety	-.68***	.66***	—
4. Objective stress (Stressful life events)	-.38***	.40***	.46***

Note. * $p < .05$, ** $p < .01$, *** $p < .001$; Correlations below diagonal represent baseline assessment (T1), and correlations above the diagonal represent follow-up assessment (T2); All correlations are significant at *** $p < .001$

Given the similarity of cross-sectional relationships across waves, temporal stability of mindfulness, subjective stress, and anxiety was examined using test-retest correlations between baseline and follow up assessments. Test-retest correlations between mindfulness, subjective stress and anxiety are shown in Table 5. All constructs demonstrated moderate to high temporal stability. Specifically, test-retest correlations were high for mindfulness as were for anxiety ($r = .63$), while subjective stress ($r = .75$) also indicated strong temporal stability. These findings suggest that individual differences in adolescents' mindfulness, subjective stress and anxiety were relatively stable across study period, while allowing for intraindividual change.

Table 5*Temporal stability of study variables*

	r (T1 - T2)
Mindfulness (CAMM)	.67***
Subjective stress	.75***
Anxiety	.63***

Note. * $p < .05$, ** $p < .01$, *** $p < .001$; Values represent Pearson test-retest correlations between baseline and follow-up assessments.

4.3. Research problem 2: Empirical testing of the proposed model of interrelationships among stress, mindfulness, and anxiety in adolescents

Second research problem and related hypotheses were tested using a moderated mediation path model estimated using structural equation modelling framework.

Given the observed stability variables included in the study, and the consistency of their temporal interrelationships, a longitudinal model was specified to test whether objective stressors and subjective stress at baseline predicted anxiety at later time point, while accounting for possible protective role of mindfulness in such model.

Hypothesized model showed excellent fit to the data CFI = 1.00, TLI = 1.00, RMSEA = .000, 90% CI [.000, .086], SRMR = .007 (Table 6). Moderated mediation model accounted for 32.1% of the variance in adolescent anxiety at follow-up. Moderated mediation model of mindfulness, objective and subjective stress, and adolescent anxiety is shown in Figure 8.

Table 6

Moderated mediation model fit indices and explained variance

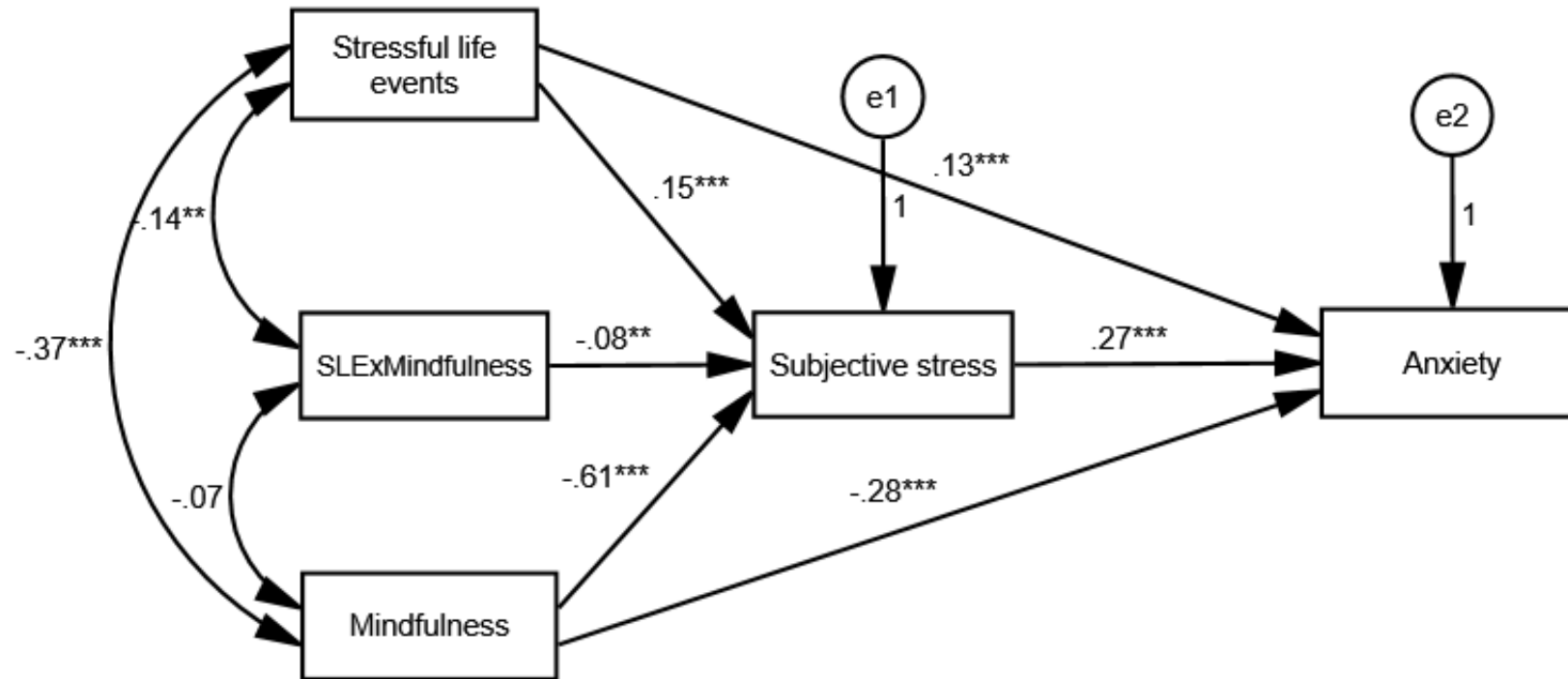
	$\chi^2(df)$	<i>p</i>	CFI	TLI	RMSEA	90% CI for RMSEA	SRMR	<i>R</i> ² Subjective stress	<i>R</i> ² Anxiety
Model	0.998 (1)	.318	1.000	1.000	.000	.000, .086	.007	.47	.32

Note. The model was estimated in *lavaan* using full maximum likelihood with 5000 bootstrap resamples. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Notably, alternative model with specified autoregressive path between later and baseline anxiety was examined, to assess whether the hypothesized associations would remain after accounting for prior levels of anxiety. However, because this model showed poor fit to the data and substantially attenuated the relationships with other predictors, it was not retained as the final model.

Figure 8

Moderated mediation model of the interrelations among mindfulness, stress and adolescent anxiety



Note. Stressful life events = objective stress; Mindfulness = trait mindfulness; SLExMindfulness = interaction term between objective stress and trait mindfulness; Subjective stress = stress appraisal; Anxiety = anxiety symptoms; Stressful life events were assessed at baseline (T1) as ‘in the past 6 months’ interval; Mindfulness and Subjective stress were assessed at baseline (T1); Anxiety was assessed at follow-up (T2). Values on the paths represent standardized coefficients. Double-headed arrows represent covariances among exogenous variables.

$**p < .01$, $***p < .001$.

Subsequent hypotheses (2a through 2d) were examined through specific model paths. Direct and indirect effects are shown in Table 7 and Table 8, respectively.

Objective stress, operationalized as count of stressful life events, significantly contributed to adolescent anxiety both directly and indirectly through subjective stress. Stressful life events showed a significant direct and positive association with later anxiety ($b = 0.01$, $SE = .003$, $\beta = .13$, $p < .001$, 95% CI [0.007, 0.020]; Table 7), as well as a significant indirect effect through subjective stress ($b = 0.004$, 95% CI [0.002, 0.006]) (Table 8).

In order to test the hypothesized moderating effect of mindfulness on subjective stress, interaction between mindfulness and stressful life events was examined (Figure 9). Interaction term was shown to be significant and negative ($b = -0.01$, $SE = 0.004$, $\beta = -.08$, $p < .005$, 95% CI [-0.017, -0.003]), although small in effect, indicating that the relationship between objective stressors and subjective stress varied in the function of mindfulness. Simple slopes are plotted in Figure 9 across three levels of trait mindfulness (low, mean, and high), illustrating that the association between objective stress and subjective stress was strongest at low mindfulness and weakened as higher levels of mindfulness

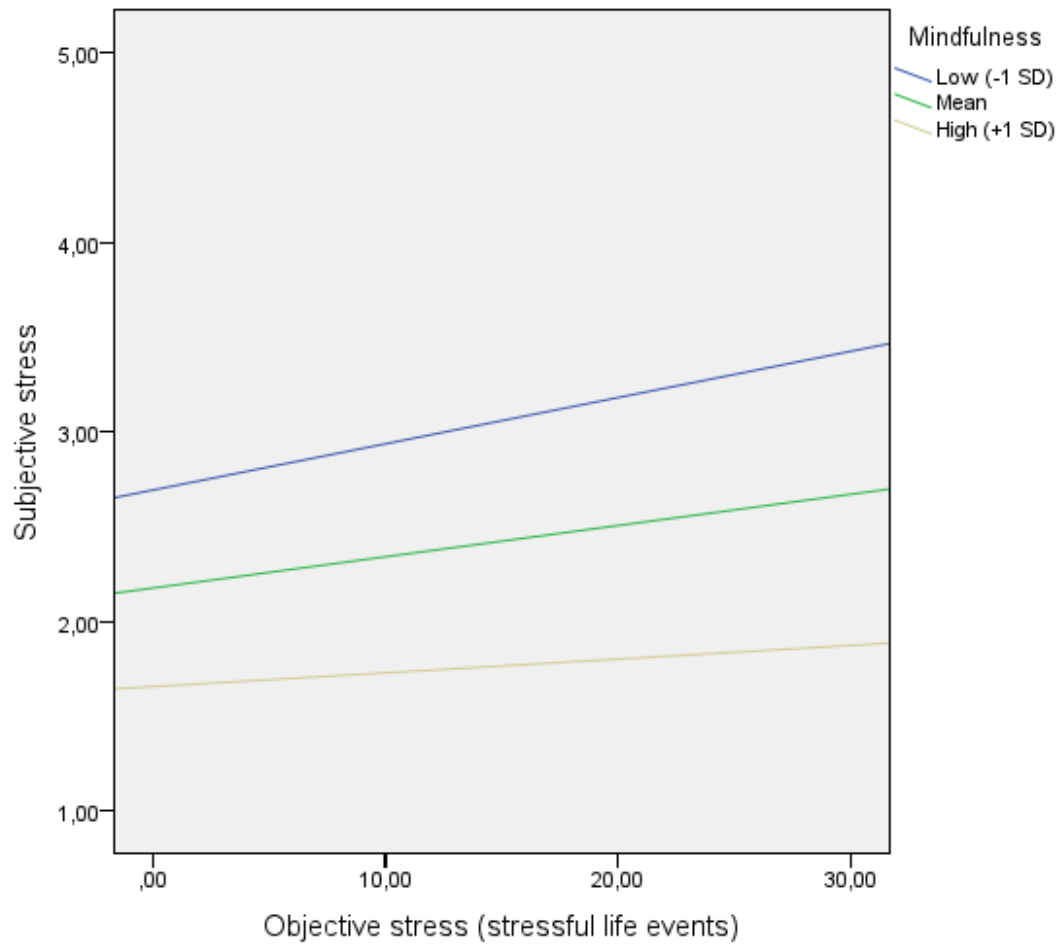
Furthermore, subjective stress significantly and positively contributed to later anxiety ($b = 0.25$, $SE = .037$, $\beta = .27$, $p < .001$, 95% CI [0.174, 0.317]), with this path showing a moderate effect.

Finally, a path from mindfulness to later anxiety, through subjective stress was examined to test the Hypothesis 2d. Mindfulness significantly contributed to lower later anxiety both directly and indirectly through subjective stress (see Tables 7 and 8 for full effects estimates). Both direct effects in this mediation are negative, with a strong direct effect on subjective stress ($\beta a = -.61$), and a moderate direct effect on anxiety ($\beta c = -.28$). The indirect effect of mindfulness on anxiety through subjective stress was negative ($b = -.15$, 95% CI [-0.199, -0.104]).

Taken together, results indicate that higher levels of objective stress (stressful life events) were significantly associated with higher levels in later anxiety, although small in effect, this path showed a significant effect, whereas mindfulness was significantly and strongly associated with lower anxiety at follow-up, as reflected in total effects. Among the tested paths, the strongest effect in the model was the concurrent negative effect of mindfulness on subjective stress, followed by the concurrent negative effect of mindfulness on anxiety. The effect of subjective stress on later anxiety was moderate, whereas the effects of stressful life events (objective stressors) on both subjective stress ($\beta = .15$), and anxiety ($\beta = .13$), were small.

Figure 9

Simple slopes of the mindfulness moderation – the association between objective stress and subjective stress at three levels of trait mindfulness



Note. Simple slopes plotted at low (-1 *SD*), mean, and high (+1 *SD*) levels of trait mindfulness. Objective stress (count of stressful life events) is plotted across the range from -1 *SD* to +2 *SD*, reflecting the observed data range while limiting extrapolation. Predictors were mean-centered prior to computation of the interaction term.

Table 7*Direct effects in the moderated mediation model predicting adolescent anxiety*

Outcome	Predictor	<i>b</i>	<i>SE</i>	95% CI	β	<i>p</i>
Subjective stress	Objective stress (Stressful life events)	.02	.003	0.010, 0.023	.15	< .001
Subjective stress	Mindfulness	-.61	.031	-0.675, -0.557	-.61	< .001
Subjective stress	Objective stress (SLE) × Mindfulness	-.01	.004	-0.017, -0.003	-.08	.004
<i>R</i>²		.47				
Anxiety	Subjective stress	.25	.037	0.174, 0.317	.27	< .001
Anxiety	Stressful life events	.01	.003	0.007, 0.020	.13	< .001
Anxiety	Mindfulness	-.25	.038	-0.329, -0.179	-.28	< .001
<i>R</i>²		.32				

Note. Unstandardized coefficients (*b*) are reported with bootstrap standard errors (*SE*) and 95% CI based on 5000 bootstrap resamples. β = standardized coefficient.

Table 8*Bootstrap confidence intervals for indirect effects on later anxiety through subjective stress*

Effect	Indirect effect (<i>b</i>)	95% CI
Objective stress (SLE) → Subjective stress → Anxiety	.004	0.002, 0.006
Mindfulness → Subjective stress → Anxiety	-.150	-0.199, -0.104
Objective stress (SLE) × Mindfulness → Subjective stress → Anxiety	-.003	-0.004, -0.001

Note. Indirect effects were estimated using 5000 bootstrap resamples; An effect was considered statistically significant when the 95% confidence interval did not include zero; First two effects represent mediation path, while the last term represents moderation effect; Values for small effect sizes are reported to three decimal places.

STUDY 2. Quasi-experimental effectiveness study – Research problem 3

4.4. Study 2: Descriptive statistics

Descriptive statistics for all variables by group and assessment timepoints are presented in Table 9. Sample sizes decreased modestly across measurement waves, reflecting expected attrition, and comparable retention patterns observed in both intervention and control group. Across all variables and measurement timepoints, distributional properties of variables indicate for univariate distributions, indicating for absence of extreme outliers. Both skewness and kurtosis values were within recommended ranges, supporting use of parametric analyses. Notably, sample sizes at post-intervention measurement were high and balanced across groups.

Across three assessments, overall variation can be seen in mean levels of mindfulness, subjective stress, anxiety, mental well-being and automatic thoughts over time. In the intervention group, mindfulness scores were at lower average at post-intervention, and higher average at baseline and follow-up. In the control group, mean mindfulness scores appeared relatively stable ranging from lower to higher average from baseline to follow-up. In both groups, no observed variable showed extreme values at any assessment point. Detailed inspection of descriptive differences in dependent variables across time is shown later in text. Given the non-randomized design and descriptive baseline differences, subsequent analyses focused on adjusted group comparisons, where these descriptive patterns were examined using ANCOVA models.

Table 9*Descriptive statistics of variables included in the quasi-experimental study shown by group*

		Group							
		Intervention (N ₁ =109, N ₂ =100, N ₃ =89)				Control (N ₁ =89, N ₂ =99, N ₃ =84)			
		<i>M</i>	<i>SD</i>	<i>IS</i>	<i>IK</i>	<i>M</i>	<i>SD</i>	<i>IS</i>	<i>IK</i>
T1	Mindfulness (CAMM)	2.29	.96	-0.41	-0.19	1.99	.76	-0.26	-0.20
	Subjective stress	2.19	.64	0.52	0.79	2.37	.55	0.53	0.29
	Anxiety	1.09	.79	0.70	-0.26	1.46	.69	0.32	-0.46
	Mental wellbeing	3.47	.69	0.96	-0.30	3.34	.71	-0.53	0.54
	Automatic thoughts (belief)	1.99	1.01	1.32	1.18	2.35	.92	0.63	-0.41
	Automatic thoughts (frequency)	1.88	.96	1.56	1.96	2.30	.99	0.77	-0.36
T2	Mindfulness (CAMM)	2.13	0.88	-0.13	-0.37	2.05	.78	-0.05	-0.40
	Subjective stress	2.31	0.73	0.44	-0.30	2.35	0.58	0.38	-0.48
	Anxiety	1.23	0.84	0.63	-0.65	1.19	0.68	0.37	-0.55
	Mental wellbeing	3.42	0.74	0.07	-0.46	3.47	0.58	0.08	-0.00
	Automatic thoughts (belief)	2.18	1.06	0.76	-0.56	2.32	1.07	0.99	0.95
	Automatic thoughts (frequency)	2.16	0.97	0.65	-0.79	2.21	0.93	0.66	-0.49
T3	Mindfulness (CAMM)	2.30	0.81	-0.13	-0.39	2.20	0.77	-0.22	-0.68
	Subjective stress	2.30	0.71	0.13	-0.97	2.26	0.53	0.71	0.54
	Anxiety	1.05	0.76	0.77	0.21	1.27	0.72	0.62	-0.26
	Mental wellbeing	3.55	0.68	0.16	-0.77	3.49	0.58	0.12	0.66
	Automatic thoughts (belief)	1.95	1.03	1.17	0.81	2.10	0.96	1.01	0.32
	Automatic thoughts (frequency)	1.89	0.92	1.10	0.42	2.02	0.88	1.12	0.80

Note. IS = skewness; IK = kurtosis

4.5. Descriptive levels of dependent variables by group and time point

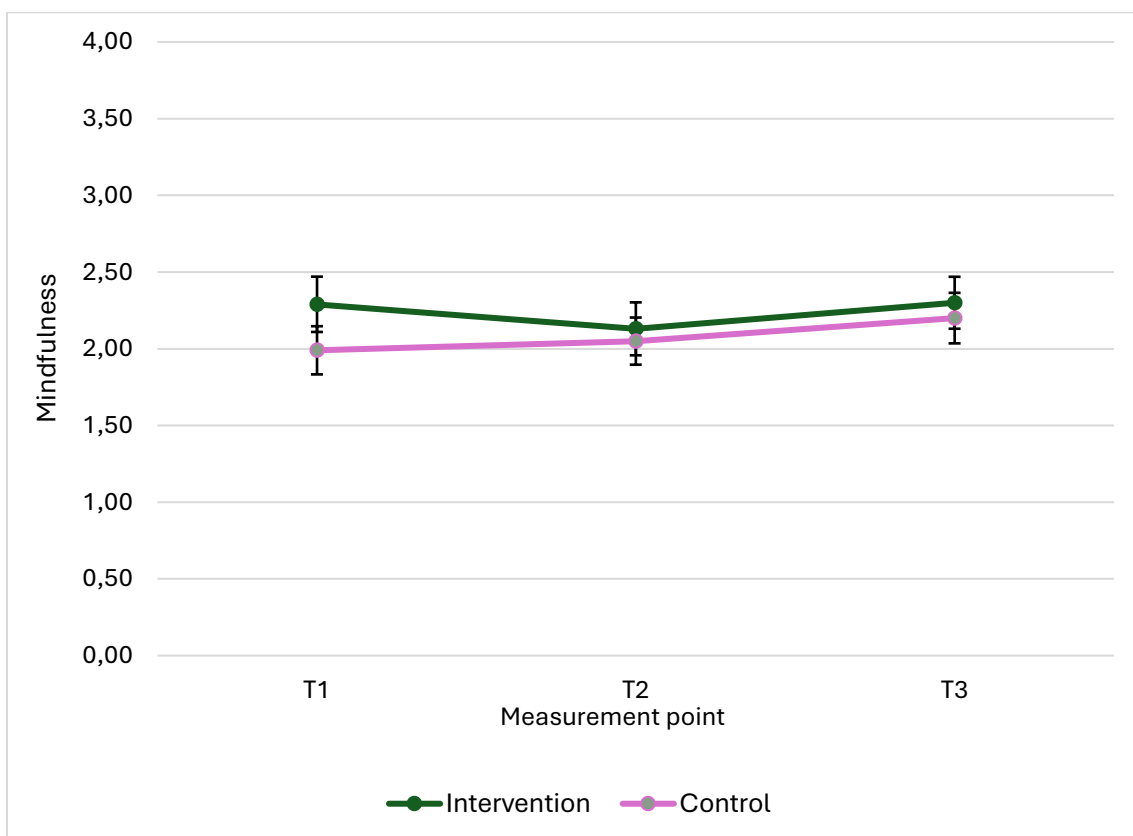
Descriptive scores for all dependent variables at each measurement point are presented below separately for the intervention and control group. The following figures show raw mean scores at baseline (T1), post-intervention (T2), and follow-up (T3) for each group. These descriptions are observational and do not reflect tested within-group differences. Inferential analyses based on ANCOVA, which examined adjusted between-group differences at each post-baseline time point while controlling for baseline scores, are reported in section 4.6.

4.5.1. Mindfulness scores by group and time point

Mean mindfulness scores by group and time point are presented in Figure 10 (descriptive only). In the intervention group, the mean score was 2.29 at baseline (T1), 2.13 at post-intervention (T2), and 2.30 at follow-up (T3). In the control group, the corresponding means were 1.99, 2.05, and 2.20. Mean scores were higher in the intervention group than in the control group at baseline (a difference of 0.30 on the 0-4 scale), with means more similar between groups at post-intervention and follow-up. Baseline-adjusted between-group differences at post-intervention (T2) and follow-up (T3) from the ANCOVA models are reported in section 4.6.

Figure 10

Descriptive mindfulness scores by group and time point



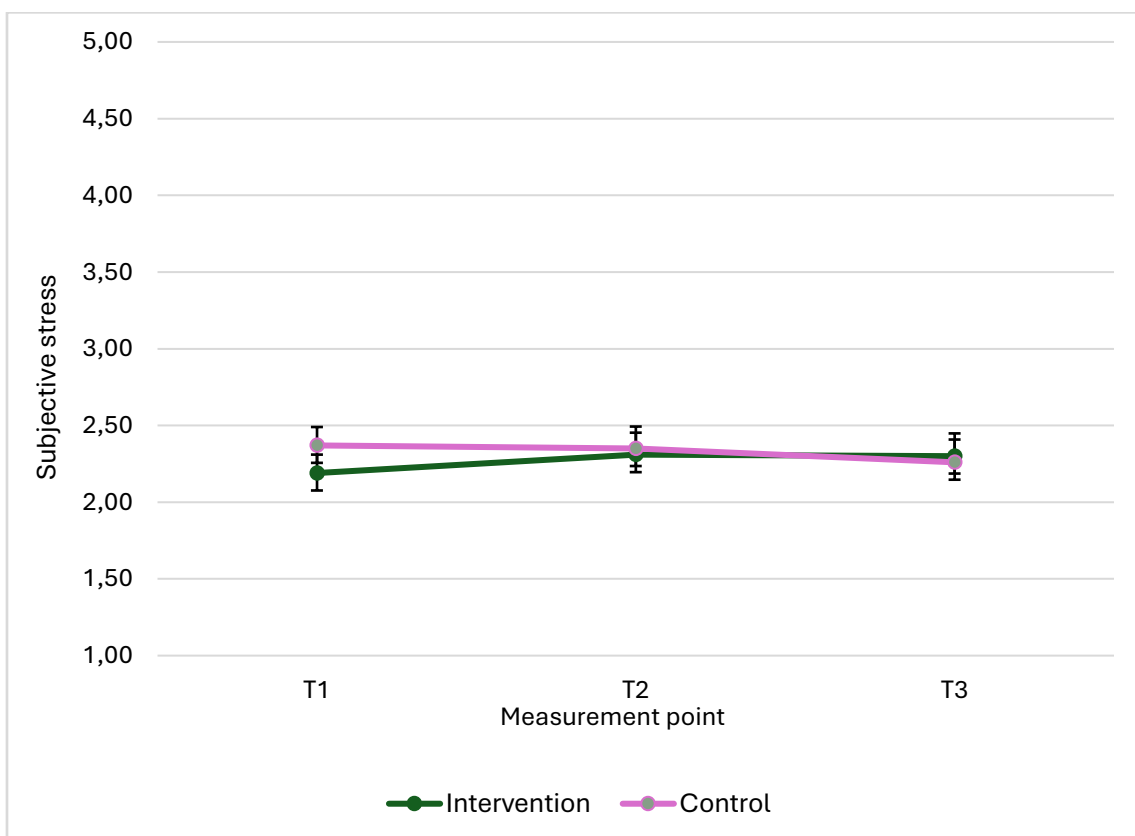
Note. Error bars represent 95% confidence intervals around the mean.

4.5.2. Subjective stress scores by group and time point

Mean subjective stress scores by group and time point are presented in Figure 11 (descriptive only). In the intervention group, the mean score was 2.19 at baseline (T1), 2.31 at post-intervention (T2), and 2.30 at follow-up (T3). In the control group, the corresponding means were 2.37, 2.35, and 2.26. Mean scores were lower in the intervention group than in the control group at baseline (a difference of 0.18 on the 1 to 5 scale), with means more similar between groups at post-intervention and follow-up. Baseline-adjusted between-group differences at post-intervention (T2) and follow-up (T3) from the ANCOVA models are reported in section 4.6.

Figure 11

Descriptive subjective stress scores by group and time point



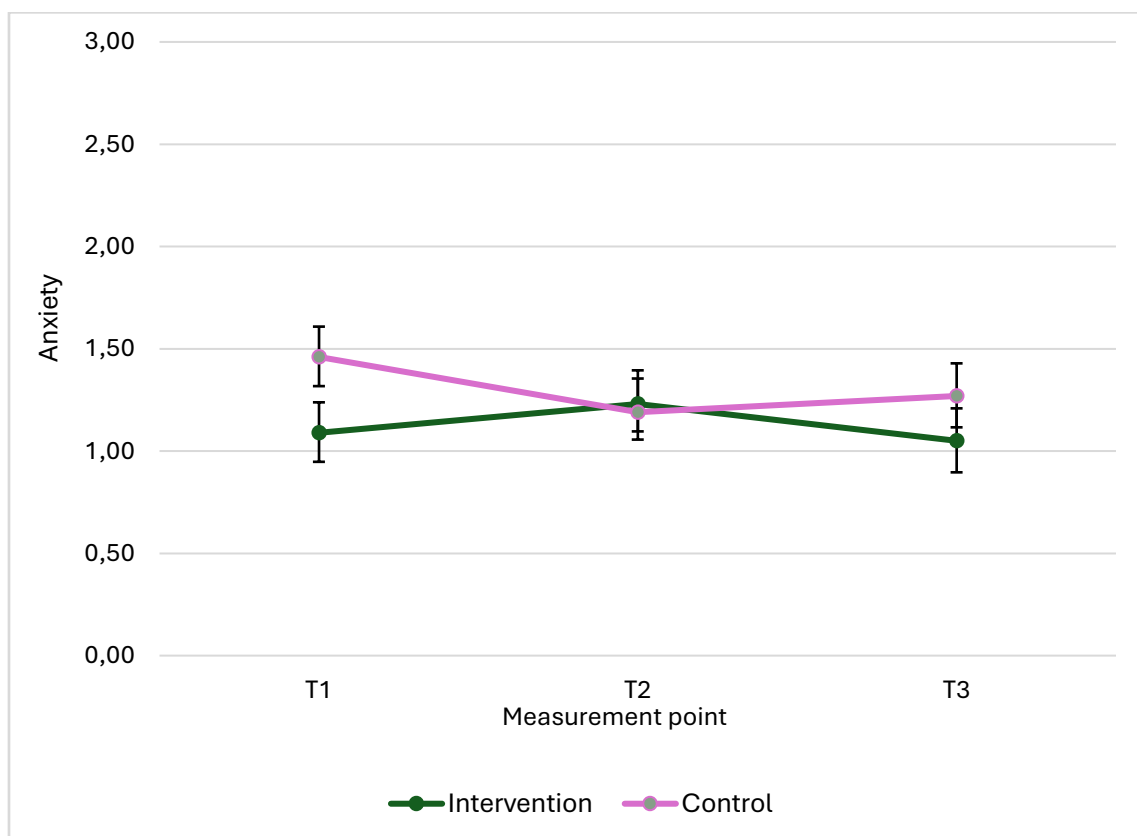
Note. Error bars represent 95% confidence intervals around the mean.

4.5.3. Anxiety scores by group and time point

Mean anxiety scores by group and time point are presented in Figure 12 (descriptive only). In the intervention group, the mean score was 1.09 at baseline (T1), 1.23 at post-intervention (T2), and 1.05 at follow-up (T3). In the control group, the corresponding means were 1.46, 1.19, and 1.27. Mean scores were lower in the intervention group than in the control group at baseline (a difference of 0.37 on the 0 to 3 scale), with means more similar between groups at post-intervention and follow-up. Baseline-adjusted between-group differences at post-intervention (T2) and follow-up (T3) from the ANCOVA models are reported in section 4.6.

Figure 12

Descriptive anxiety scores by group and time point



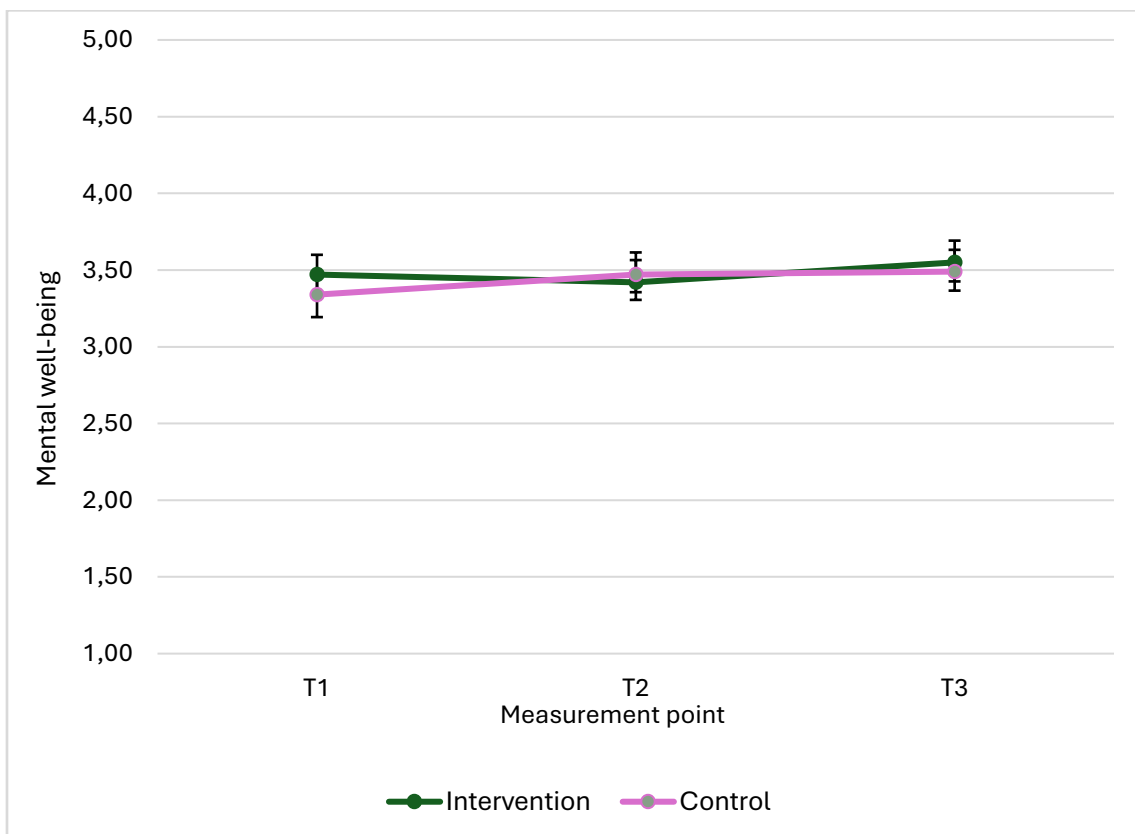
Note. Error bars represent 95% confidence intervals around the mean.

4.5.4. Mental well-being scores by group and time point

Mean mental well-being scores by group and time point are presented in Figure 13 (descriptive only). In the intervention group, the mean score was 3.47 at baseline (T1), 3.42 at post-intervention (T2), and 3.55 at follow-up (T3). In the control group, the corresponding means were 3.34, 3.47, and 3.49. Mean scores were slightly higher in the intervention group than in the control group at baseline (a difference of 0.13 on the 1 to 5 scale), with means similar between groups at post-intervention and follow-up. Baseline-adjusted between-group differences at post-intervention (T2) and follow-up (T3) from the ANCOVA models are reported in section 4.6.

Figure 13

Descriptive mental well-being scores by group and time point



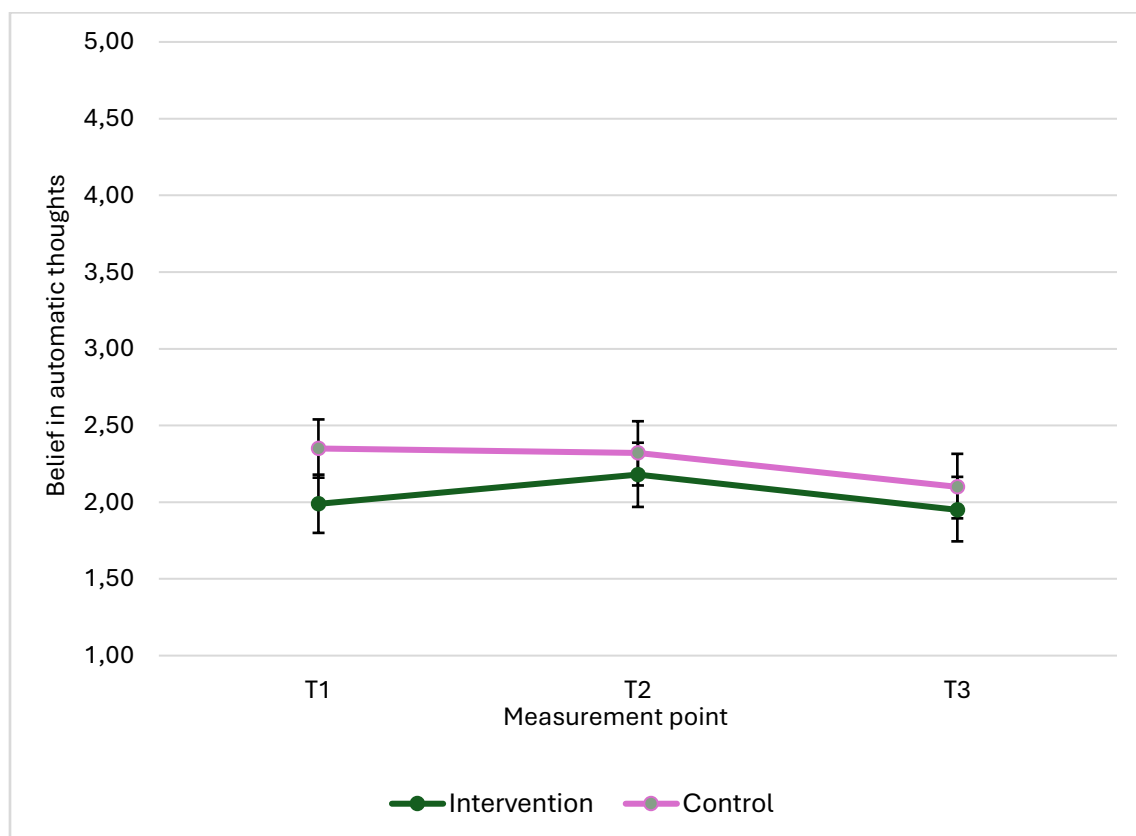
Note. Error bars represent 95% confidence intervals around the mean.

4.5.5. Belief in automatic thoughts by group and time point

Mean belief in automatic thoughts scores by group and time point are presented in Figure 14 (descriptive only). In the intervention group, the mean score was 1.99 at baseline (T1), 2.18 at post-intervention (T2), and 1.95 at follow-up (T3). In the control group, the corresponding means were 2.35, 2.32, and 2.10. Mean scores were lower in the intervention group than in the control group at baseline (a difference of 0.36 on the 1 to 5 scale), with means more similar between groups at post-intervention and follow-up. Baseline-adjusted between-group differences at post-intervention (T2) and follow-up (T3) from the ANCOVA models are reported in section 4.6.

Figure 14

Descriptive belief in automatic thoughts scores by group and time point



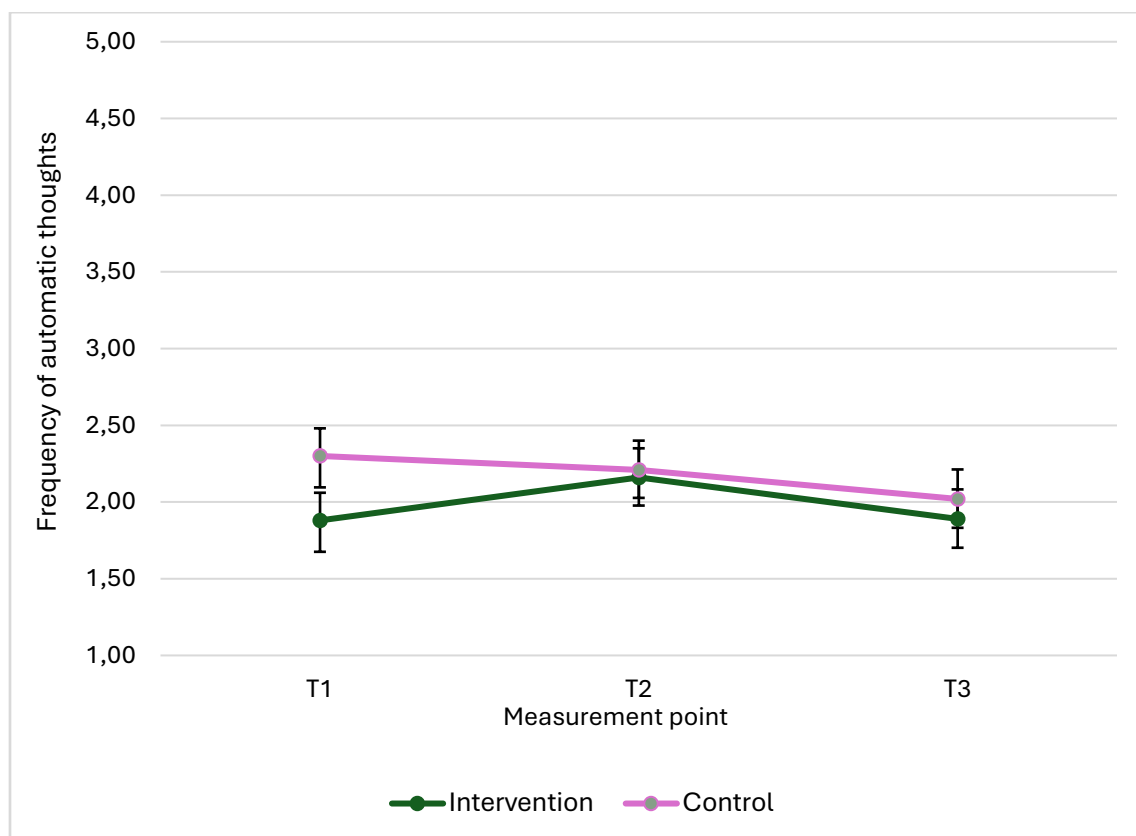
Note. Error bars represent 95% confidence intervals around the mean.

4.5.6. Frequency of automatic thoughts by group and time point

Mean frequency of automatic thoughts scores by group and time point are presented in Figure 15 (descriptive only). In the intervention group, the mean score was 1.88 at baseline (T1), 2.16 at post-intervention (T2), and 1.89 at follow-up (T3). In the control group, the corresponding means were 2.30, 2.21, and 2.02. Mean scores were lower in the intervention group than in the control group at baseline (a difference of 0.42 on the 1 to 5 scale), with means more similar between groups at post-intervention and follow-up. Baseline-adjusted between-group differences at post-intervention (T2) and follow-up (T3) from the ANCOVA models are reported in section 4.6.

Figure 15

Descriptive frequency of automatic thoughts scores by group and time point



Note. Error bars represent 95% confidence intervals around the mean.

4.6. Research problem 3: Evaluating the effect of mindfulness-based intervention on the perception of stress and adolescent mental health

To evaluate the short and long term effectiveness of the mindfulness-based intervention on adolescent mental health outcomes (mindfulness, subjective stress, anxiety, mental well-being, and frequency and belief in automatic thoughts), separate analyses of covariance (ANCOVA) were estimated for each outcome. Post-intervention (T2) and follow-up (T3) scores for each outcome were analyzed in separate models, with baseline (T1) scores entered as covariates. Group (intervention versus control) was specified as the between-subjects factor.

Preliminary analyses were conducted to test the assumptions of ANCOVA. Inspection of descriptive indicators (skewness and kurtosis values reported in Table 9) indicated approximately normal distributions and absence of extreme outliers for all variables. Pearson correlations between baseline (T1) scores and post-intervention or follow-up scores were moderate to strong across outcomes, supporting the use of baseline scores as covariates (reported in supplementary Table 3a). Visual inspection of scatterplots confirmed that the relationship between each baseline covariate and the corresponding T2 or T3 outcome was approximately linear in both groups.

The assumption of homogeneity of regression slopes was examined by testing the baseline x group interaction term for each outcome at each post-baseline time point. At post-intervention (T2), all covariate x group interactions were non-significant (all $p > .05$), indicating that the relationship between baseline and T2 scores did not differ between the intervention and control group. At follow-up (T3), the assumption was met for five of the six outcomes; for belief in automatic thoughts, the baseline x group interaction was statistically significant, indicating that the relationship between baseline and T3 belief scores differed between groups. Accordingly, for this outcome, the baseline x group interaction was retained in the model and the effect at follow-up was examined as moderated (conditional) effect.

Homogeneity of variances across measured variables was tested by Levene's test, for both post-intervention (T2) and follow-up (T3) for each outcome, and is reported if result is significant. The assumption was met for all outcomes except subjective stress, where Levene's test indicated unequal error variances between groups at both T2 and T3. ANCOVA results for subjective stress are therefore reported with caution, given that ANCOVA is relatively robust to violations of variance homogeneity when group sizes are comparable, as was the case in this study (Wilcox, 2017).

The baseline-adjusted between-group differences from the ANCOVA models are presented in Table 10 (post-intervention, T2), Table 11 (follow-up, T3, standard models), and Table 12 (follow-up, T3, conditional model for belief in automatic thoughts).

At post-intervention (T2), no statistically significant between-group differences were observed for subjective stress ($F(1,161) = 0.42, p = .52, \eta^2_p = .003$), or mindfulness as measured by CAMM ($F(1, 161) = 2.05, p = .154, \eta^2_p = .01$).

Observing T2 ANCOVA results concerning adolescents' anxiety, mental well-being, and frequency of automatic thoughts, the pattern of significant difference between groups can be seen (Table 10). After adjusting for baseline scores, the control group showed higher adjusted mean mental well-being scores than the intervention group ($F(1, 161) = 5.15, p = .025, \eta^2_p = .03$). The intervention group showed higher adjusted mean anxiety scores ($F(1, 161) = 8.12, p = .005, \eta^2_p = .05$) and higher adjusted mean frequency of automatic thoughts ($F(1, 161) = 4.46, p = .036, \eta^2_p = .03$) than the control group. No statistically significant between-group difference was observed for belief in automatic thoughts ($F(1, 161) = 1.50, p = .223, \eta^2_p = .009$). Effect sizes across all six outcomes were small to lower-moderate in magnitude ($\eta^2_p = .01 - .05$), indicating for modest post-intervention differences.

Table 10*Post-intervention (T2) ANCOVA results (N = 165)*

Outcome	Intervention group (N=86) M_adj (SE)	Control group (N=79) M_adj (SE)	F(1, 162)	p	η^2_p
Mindfulness (CAMM)	2.09 (0.06)	2.21 (0.06)	2.33	.129	.014
Subjective stress (PQ)	2.29 (0.05)	2.25 (0.05)	0.42	.520	.003
Anxiety (GAD)	1.30 (0.06)	1.05 (0.06)	8.12	.005**	.048
Mental well-being (MWB)	3.35 (0.05)	3.50 (0.05)	5.15	.025*	.032
Automatic thoughts (beliefs)	2.28 (0.08)	2.15 (0.08)	1.50	.223	.009
Automatic thoughts (frequency)	2.25 (0.06)	2.06 (0.7)	4.46	.036*	.027

Note. η^2_p = partial eta squared; Estimated marginal means are adjusted for baseline (T1) scores from separate univariate ANCOVA models for each outcome. Within each model, pairwise comparisons between the intervention and control group used the Bonferroni adjustment available in the SPSS GLM procedure. Reported *p*-values are evaluated at $\alpha = .05$; significance markers indicate **p* < .05, ***p* < .01. Values for small effect sizes are reported to three decimal places.

At follow-up (T3), analyses of covariance examining long-term program effectiveness were conducted entering T3 outcomes as dependent variables and baseline (T1) scores as covariates. For belief in automatic thoughts, the assumption of homogeneity of regression slopes was not confirmed. Therefore, the interaction between baseline scores and group was retained to model conditional effects.

Results examining long-term program effectiveness suggest that no statistically significant differences were found between control and intervention groups for any of the outcomes assessed using standard ANCOVA models, as presented in Table 11. No observed group difference was found for mindfulness as measured by CAMM at follow-up ($F(1, 144) = 0.57, p = .45, \eta^2_p = .004$). The effect size is negligible, indicating comparable levels of mindfulness in both groups after adjusting for baseline levels. No difference in perception of stress was observed between groups at follow up, although the intervention group reported slightly higher adjusted subjective stress scores ($F(1, 144) = 2.70, p = .10, \eta^2_p = .02$). Although borderline significant, this effect did not reach statistical significance. Accordingly, no other mental health outcome scores were observed significantly different between groups at follow-up (T3) assessment. Effect sizes across outcomes were small to negligible, indicating convergence of both groups across time.

Tests for interaction effects for outcomes with violated homogeneity assumption are shown in Table 12. For beliefs in automatic thoughts, significant interaction (group x baseline) was observed at follow-up ($F(1, 144) = 4.48, p = .03, \eta^2_p = .04$), indicating that group differences in belief in automatic thoughts at T3 depended on baseline belief levels. When the homogeneity assumption was violated, main group effects were not reported for this outcome. These findings indicate that at follow-up (T3), the effects of the mindfulness-based intervention were baseline-dependent, particularly observed for the belief in reported automatic thoughts at follow-up (T3).

Table 11*Follow-up (T3) standard ANCOVA models (N=147)*

Outcome	Intervention group (N=78) M_adj (SE)	Control group (N=69) M_adj (SE)	F(1, 144)	p	η^2_p
Mindfulness (CAMM)	2.28 (0.06)	2.35 (0.07)	0.57	.451	.004
Subjective stress (PQ)	2.29 (0.05)	2.17 (0.05)	2.70	.103	.018
Anxiety (GAD)	1.05 (0.06)	1.06 (0.07)	0.02	.883	.00
Mental well-being (MWB)	3.57 (0.05)	3.49 (0.06)	1.23	.270	.01
Automatic thoughts (frequency)	1.93 (0.08)	1.84 (0.8)	0.57	.455	.004

Note. η^2_p = partial eta squared; Estimated marginal means are adjusted for baseline (T1) scores from separate univariate ANCOVA models for each outcome. Within each model, pairwise comparisons between the intervention and control group used the Bonferroni adjustment. Reported p-values are evaluated at $\alpha = .05$; significance markers indicate $*p < .05$, $**p < .01$. Values for small effect sizes are reported to three decimal places.

Table 12*Follow-up (T3) conditional effects (N=137)*

Outcome	Effect tested	<i>F</i>(1, 144)	<i>p</i>	η^2_p
Automatic thoughts (beliefs)	baseline x group	4.78	.031	.035

Note. $N_{\text{intervention}} = 70$, $N_{\text{control}} = 67$; η^2_p = partial eta squared; Conditional ANCOVA model retained the baseline x group interaction term for outcomes where the homogeneity of regression slopes assumption was violated. For these outcomes, main effects of group are not reported. Reported p-values are evaluated at $\alpha = .05$. Values for small effect sizes are reported to three decimal places.

5. DISCUSSION

The aim of this dissertation was to explore the relationship between exposure to objective stressors and psychological or subjective stress, mindfulness, and anxiety among adolescents, and to examine the effect of mindfulness-based intervention on adolescents' perception of stress and mental health. To address this aim, the research combined two complementary research designs. Longitudinal Study 1 focused on the interrelationships among mindfulness, objective and subjective stress, and adolescent anxiety, and empirically tested the proposed model of relationships between the selected constructs. Study 2 focused on the effectiveness of a school-based mindfulness program on adolescent stress and mental health outcomes. Accordingly, the discussion sections are organized by study first and research problem second.

STUDY 1. Longitudinal study

5.1. Research problem 1: Interrelationships between mindfulness, psychological stress, and anxiety

The first research problem of this study focused on determining the interrelationships between mindfulness, psychological stress, and anxiety in a sample of Croatian adolescents. Therefore, it was hypothesized that mindfulness would be negatively associated with both subjective stress and anxiety in adolescents, while subjective stress and adolescent anxiety would be positively correlated. Accordingly, this hypothesis was fully confirmed.

Higher trait mindfulness was significantly associated with lower subjective stress and lower adolescent anxiety. On the other hand, higher subjective stress was significantly associated with higher later adolescent anxiety. The observed correlational patterns are fully consistent with research evidence suggesting that both objective and subjective stress are related to symptoms of anxiety in adolescence, while mindfulness is associated with lower distress outcomes and better emotional capacity (Pepping et al., 2016; Weinstein et al., 2009). While these findings only support correlational associations between the observed constructs, more complex relationships between mindfulness, stress, and adolescent anxiety are examined within the tested model and thus discussed in the following chapter.

Furthermore, although not specifically hypothesized, insightful evidence on associations between subjective stress, mindfulness, and anxiety with objective stress (measured as the count of stressful life events) is presented. Higher exposure to stressful life events was significantly and strongly associated with higher subjective stress levels and higher later adolescent anxiety, while the association between objective stressors and mindfulness was negative and moderate. These findings support the conceptual distinction between exposure to objective stressors and subjective psychological stress. A moderate to strong, but not full, correlation with subjective stress suggests that these two measures represent distinct concepts. While the count of stressful life events indicates that stressors occurred, subjective stress relates to stress appraisal as the psychological burden of such stressors. This distinction is central to the modern stress research (Shields & Slavich, 2017; Slavich, 2016, 2020). Accordingly, the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984, 2004) argues that the stress response does not rely solely on event exposure. Rather, subjective stress, or subjective appraisal determines the extent to which objective stressors have psychological consequences in the form of mental health outcomes. Thus, the present findings support the claim that adolescent anxiety is associated not only with the occurrence of stressful events, but also on the subjective appraisal of those events. These findings support the stress sensitization model (Stroud, 2020). However, the comprehensive interpretation of results is later presented within the empirical model.

Moderate to strong, negative correlations between mindfulness and subjective stress and later anxiety were confirmed both within the same measurement, wave, as well as temporally. These findings are further supporting the evidence that trait mindfulness is consistently negatively correlated with stress, anxiety, and maladaptive cognitions in adolescence (Brown & Ryan, 2003; Weinstein et al., 2009). These results are especially considering that the sample consisted of Croatian adolescents, who were minimally exposed to universal mindfulness-based training.

The presented results should be interpreted with caution, as this research problem merely focuses on associations between constructs, and does not explain the causality or temporal ordering, which is observed and later discussed within the findings regarding model testing. However, by confirming the first hypothesis, these findings further establish coherent patterns of associations that are supported by cross-cultural research findings. Furthermore, the established associations contribute to the claim that mindfulness is a plausible protective factor for adolescent mental health when examined within the stress processing model.

5.2. Research problem 2: Empirical testing of the moderated-mediation model of interrelationships among stress, mindfulness, and anxiety in adolescents

The second research problem focused on the empirical testing of the model of interrelationships among stress, mindfulness, and anxiety in adolescents. The proposed model integrates the theoretical rationale from the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984), and stress sensitization model (Stroud, 2020), as well as the dual mindfulness role in the stress-anxiety pathways. Therefore, it was hypothesized that the model in which objective stress, mediated by psychological stress, contributes to anxiety, while mindfulness, through both mediation and moderation in the relationship between objective stressors and psychological stress, reduces it, would be acceptable based on model fit indices. This hypothesis was fully confirmed, and the model was fully supported by the data. Therefore, providing the center argument of this dissertation.

Objective stressors, mindfulness, and their interaction predicted psychological, or subjective stress in adolescents. Subjective stress, then, predicted later adolescent anxiety. Mindfulness, however, exhibited a dual role in these pathways. Objective stressors directly and positively predicted to later anxiety, while mindfulness directly and negatively predicted later adolescent anxiety. This model provides a layered perspective on adolescent anxiety, where anxiety is not considered merely as an outcome of stress exposure, but rather as a result of stress processes and mindfulness. Specific model pathways are further discussed.

5.2.1. Stress sensitization and stress appraisal pathways

The conceptual distinction between objective and subjective stress, fully established in this research, is reflected in the distinctive contribution of objective stressors and subjective stress to subsequent anxiety. Stressful life events contributed directly and positively to later anxiety, but they also contributed indirectly, mediated by subjective stress. This confirmed pathway has theoretical importance, as it suggests that exposure to stressors does not fully and solely result in the heightened anxiety. Rather, the association between objective stressors and anxiety depends on stress appraisal. This finding is aligned with the Transitional Model of Stress and Coping (Lazarus & Folkman, 1984, 2004). Furthermore, this result aligns well with Slavich's (2016) argument that stress measurement should account for both stressor occurrence and stress appraisal. This research shows that stress exposure and stress appraisal are related, but do not reflect the same mechanism in anxiety development.

Secondly, this model supports the claim for a stress sensitization mechanism (Stroud, 2020), and reflects the assumption that individuals who have experienced prior stress become more vulnerable (or sensitized) to later stressors (Hammen, 2005). Due to the sensitization mechanism, less severe stressors reach the threshold for producing the stress response. Stroud (2020) further extended this approach to adolescence, suggesting that adolescence poses a developmental window for increased sensitization due to biological, social, and cognitive changes. The examined model supports this framework. Stressful life events significantly predicted later higher subjective stress, and higher subjective stress predicted later adolescent anxiety.⁵ This pathway is fully consistent with the sensitization mechanism and provides valuable insight into stress processes that translate into later anxiety in adolescence. Similar longitudinal findings are reported by Gotlib et al. (2021), who reported evidence of stressful life events contributing to later perceived stress, which then later predicted adolescent depression symptoms. However, the same pathway has not been previously examined in relation to adolescent anxiety.

Finally, the path from subjective stress to later anxiety should be mentioned. Later anxiety was predicted by objective stress, but also by the levels of subjective stress at baseline. This supports the understanding of anxiety development as an accumulation of risk, which directly translates into the prevention perspective. Therefore, if subjective stress represents a mechanism through which environmental events translate into the symptoms of mental health problems, prevention should not only try to reduce the risk of exposure to stressful events, but also account for the appraisal process through which environmental stressors become psychologically harmful.

5.2.2. Dual role of mindfulness

The dual role of mindfulness is possibly the core of this examined model. These two distinct roles – mindfulness as a moderator of stress exposure, and as a protective agent for stress appraisal and later anxiety, within the same model are not redundant, but rather reflect different points in the stress process and concern distinctive underlying cognitive mechanisms that arise from mindfulness. First, the moderating role of mindfulness was established in the

⁵ Important to note is that the objective stress was measured as the count measure of stressful life events, assessed at the same time-point as subjective stress, but the measure reflected event count for the period of the past year. Thus, it is valid to argue that the objective stressors present another time-point of the assessment, prior to the assessment of subjective stress.

relationship between objective stressors and subjective stress, suggesting for the buffering effect of mindfulness. Second, a protective role of mindfulness in relation to stress appraisal and later anxiety was confirmed. This duality was theoretically grounded in the Mindfulness-to-Meaning Theory (Garland, 2007; Garland et al., 2009, 2011, 2015a 2015b, 2017) and aims to clarify that the moderating and protective roles reflect two manifestations of a single mindfulness capacity.

Moderating role

At high levels of mindfulness, objective stressors no longer translated into subjective psychological stress. The significant interaction between mindfulness and objective stressors in the prediction of subjective stress was observed and suggests the buffering process. The moderation hypothesis reflects the positioning of mindfulness within the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984). Garland et al. (2009, 2015b) suggest that mindfulness decenters the individual from stress appraisal into a metacognitive awareness which broadens attention capacity. Accordingly, mindfulness decreases the extent to which objective stressors are translated to subjective stress, thus making adolescents less vulnerable into the sensitization pathway. At high levels of mindfulness, objective stressors no longer translated into subjective psychological stress. Through this moderating role, mindfulness deautomatizes the habitual stress response (Garland et al., 2015a, 2015b). This finding also reflects Kabat-Zinn's (1990) argument that mindfulness deautomatizes habitual cognitive patterns of reactivity to stress and supports decentering. The moderating role of mindfulness in the translation of objective stressors into subjective stress also reflects the Mindfulness Stress Buffering Account (Creswell & Lindsay, 2014), which suggests that mindfulness strengthens both top-down cognitive processes (Garland et al., 2010, 2017) that reflect regulation, and attenuates bottom-up physiological reactivity, so that objective stressors are less likely to exacerbate psychological stress. The observed moderating role of mindfulness in the proposed model further supports Creswell and Lindsay's (2014) hypothesis and provides evidence from an adolescent sample and longitudinal design.

Protective role

The second role of mindfulness in this model is protective, observed in the mindfulness – stress – anxiety pathway. Higher mindfulness significantly contributed to lower later anxiety, both independently, and through the mediation of subjective stress. Higher mindfulness also predicted lower subjective stress, which resulted in lower anxiety levels. This pathway is best

understood as an extension of the same mechanism observed in the moderation path. Thus, the same metacognitive capacity that shapes stress appraisal, also reduces the downstream effect of stress, thereby having a protective effect on subsequent anxiety.

These findings on the dual role of mindfulness in the stress process are well aligned with the Mindfulness-to-Meaning Theory (MMT; Garland et al., 2015b). The protective path suggests that mindfulness not only reduces the translation of objective stressors to subjective response, but also broadens attention, allowing for the cognitive shift and the reinterpretation of events. This pathway is directly reflected in the effect from mindfulness to later anxiety. The direct path is noteworthy because it suggests that mindfulness contributes to later lower anxiety through processes that are not captured by the present model, thereby suggesting that mindfulness effects cannot be reduced only to stress reduction. Rather than only contributing to modified stress reappraisal, mindfulness influences the downstream emotional response (Garland et al., 2015a, 2015b, 2017). Several possible cognitive mechanisms are plausible underlying processes in this unmeasured pathway. Building on metacognitive awareness and considering Wells' (1995, 2006) Metacognitive Model of Generalized Anxiety, positive beliefs about the utility of worry and negative beliefs about uncontrollability likely reflect an unmeasured process in these pathways. Wells (2006) further notes that decentering from negative thoughts and attention training are core mindfulness mechanisms that support adaptive metacognitive patterns. The presented model thus indicates that the protective role of mindfulness in adolescent mental health operates through multiple pathways. Stress reappraisal is one such pathway, but the direct mindfulness–anxiety effect likely also reflects metacognitive processes (Wells, 2006), which are addressed in the second study.

Taken together, these findings suggest that mindfulness is a single metacognitive capacity that operates at multiple points in the stress-anxiety process. This is consistent with the Mindfulness-to-Meaning Theory (Garland et al., 2009, 2015b) which positions mindfulness as a set of core cognitive resources — attentional control, metacognitive awareness, and cognitive flexibility — that are engaged differently depending on the regulatory demand. At the appraisal stage, this capacity manifests as moderation; at the level of anxious cognitions, it manifests as a protective effect.

STUDY 2. Quasi-experimental effectiveness study

5.3. Research problem 3: Evaluating the effect of mindfulness-based intervention on the perception of stress and adolescent mental health

The third research problem encompassed Study 2 and examined the effectiveness of a mindfulness-based intervention on the perception of stress and adolescent mental health. Therefore, it was hypothesized that levels of mindfulness, subjective stress, anxiety and mental well-being would significantly differ between intervention and control groups after the intervention. The underlying mechanism was also examined, and it was hypothesized that the strength (or frequency) and belief in automatic thoughts would also significantly differ between the two groups of adolescents. This hypothesis was not confirmed, and patterns inverse to those assumed were observed.

Findings at post-intervention (T2) and follow-up (T3) assessments did not support the claim that the mindfulness-based intervention would have beneficial preliminary effects to mental health outcomes. At the post-intervention (T2) assessment, the intervention group did not report an advantage in trait mindfulness compared to the control group, as assumed. Moreover, no difference was observed in levels of psychological stress between groups, indicating that the intervention group did not benefit from mindfulness training with regard to subjective stress levels. Negative patterns in other mental health outcomes and process mechanisms were also observed. Anxiety symptoms were higher among adolescents in the intervention group after adjusting for baseline anxiety levels, and showed low to moderate effect. Conversely, mental well-being was higher among adolescents in the control group, with ANCOVA model showing modest effect. At the follow-up (T3) assessment, standard ANCOVA outcomes were non-significant, suggesting that adolescents in the intervention group did not benefit from mindfulness training, when compared to the passive control group.

5.3.1. Effects on mindfulness trait and subjective stress

Contrary to expectations, the mindfulness-based program was not proven beneficial for mindfulness nor subjective stress, regardless of the assessment point. Thus, both trait mindfulness and subjective stress levels did not differ between groups after adjusting for baseline scores. While implementation factors are discussed throughout this section to contextualize the observed effects, the focus of Study 2 was the preliminary effectiveness of the program rather than its implementation per se. A systematic implementation evaluation,

which would include fidelity, dosage, and engagement metrics, falls outside the scope of the present study and is identified as a direction for future research. These findings are discussed below from the prevention and implementation perspective but should also be interpreted considering the empirical pathways tested in the model of Study 1.

The examined longitudinal model supported subjective stress as the central pathway to later adolescent anxiety, with trait mindfulness shaping this effect. The effectiveness study then tested the effects of mindfulness training on trait mindfulness, subjective stress and mental health outcomes. However, Study 2 did not support the protective role of mindfulness practice examined in the model. Neither mindfulness nor subjective stress improved at the post-intervention (T2) or follow-up (T3) assessment. These findings point to the critical discrepancies between the observed model and intervention effects. According to the model pathways, if mindfulness trait shaped the relationship between subjective stress and later anxiety, and if the delivered program did cultivate this educable mindfulness skill (as Roeser et al., 2022, suggested), then the mindfulness training should have activated the protective pathways identified in the model (Study 1). However, the delivered mindfulness training did not produce measurable results in mindfulness trait levels. Therefore, the mechanism identified in Study 1 was not engaged by the intervention applied in Study 2, at least not in the shape and form the program was delivered. Additionally, the program duration should be noted here, while the six-session program seems insufficient to produce improvements in either trait mindfulness or anxiety levels.

It is important to note that these results do not weaken the findings from Study 1. Greenberg et al. (2001) noted that identifying the relevant mechanism does not necessarily translate into successful modification of that mechanism. The implementation conditions for the delivery of the program encompassed in this effectiveness study were not favorable for program effectiveness. This is further supported by Roeser et al. (2022), who emphasized the importance of student engagement with personal mindfulness practice for the educable skill to be integrated and reflected in changes in trait levels. Lucas-Thompson et al. (2020) note that adolescents' compliance with personal at home practice is commonly low, which affects MBIs effectiveness results. Therefore, recent studies examining MBIs effectiveness advocate for the skill transfer techniques that would improve adolescent engagement with both formal and informal mindfulness practice, especially with mindfulness practice at home. Lucas-Thompson et al. (2020) suggest that regular motivational reminders, support for adolescents to incorporate low effort and daily informal mindfulness, and didactic techniques such as an online and on-

demand mindfulness library are some of the possible actions that would support adolescent mindfulness practice and foster skill transfer. Digital platforms are increasingly used as a primary delivery outlet for MBIs, where such tools allow for adaptive learning that adolescents can tailor to personal needs (Lahtinen & Salmivalli, 2020; Mihić, 2025). Moreover, short mindfulness practices that adolescents can easily use in high-need situations, such as acute stress, are proposed to further mindfulness skills and adolescent engagement with daily formal practice (Lucas-Thompson et al., 2020).

These findings should be also interpreted in light of the mindfulness stress buffering account (Creswell & Lindsay, 2014), which suggest that mindfulness benefits are most prominent under conditions of higher stress. In populations with relatively low stress, mindfulness may not produce benefits, as observed in this study. Adolescents in this sample initially reported mid-scale levels of subjective stress. Given that their initial stress levels were not elevated, the program would be expected to produce small or no effects. The present findings are further supported by Helminen et al. (2022) who examined the effectiveness of Learning to BREATHE in adolescents across different stress conditions, and found that the program produced beneficial effects during periods of high stress.

Additionally, it is important to note that the L2B program in this study was delivered as the universal prevention program for the whole generation of high-school students for the selected school. Therefore, only students with serious mental health problems, and those already being provided with counselling (especially CBT and/or MBCT treatment) could not participate in the program. Student motivation for participating in the program should therefore be considered as an important factor for engagement, which in turn contributed to the program effectiveness.

Another plausible explanation for the limited effects of the mindfulness program in this study, concerns the developmental fit between the mindfulness program (L2B) and the age of the participants. Although Learning to BREATHE was initially developed for senior high-school students with an average age of 17 years (Broderick & Metz, 2009), newer evidence on MBIs effectiveness indicates that universal SBMIs do not motivate adolescents sufficiently, for them to engage in regular and sustained mindfulness practice (Galla, 2023). Adolescents often report the irrelevance and boredom of meditation practice, which are directly linked with intervention effects in the adolescent population (Galla, 2023). Additionally, because high-school students in the present sample were not self-selected for participating in the program, and the majority

were not facing significant difficulties which would make the mindfulness training personally meaningful for them, the conditions for engagement with personal practice were not met. Consequently, this is largely reflected in the program effectiveness.

Taken together, these findings imply that the effects of the selected program are likely conditional to broader stress context (e.g., stressfulness of the school period – such as the exam versus non-exam period), while effects on mindfulness trait levels largely depend on the personal engagement, which in turn contributes to the consolidation of mindfulness skills that is not immediately reflected in the changes in trait mindfulness (Roeser et al., 2022). Therefore, whether the benefits of mindfulness training will be reflected in the trait levels may be largely shaped by personal practice and its persistence over a longer time period.

Finally, it is important to note that the Learning to BREATHE curriculum is not a classical mindfulness training such as MBCT or MBSR, although it is based on MBSR principles (Broderick, 2013; Lucas-Thompson et al., 2020). Rather, this program incorporates mindfulness with socio-emotional learning elements, such as emotional regulation. Although adolescence presents as a developmentally opportune period for strengthening socio-emotional skills due to neuroplasticity (Fuhrmann et al., 2015), the consolidation of socio-emotional learning skills occurs over a longer period. Therefore, six-session program included in this study, was possibly too short and insufficient in dosage to support consolidation of socio-emotional skills, and thus produce significant effects. Furthermore, evidence supports the effectiveness of classical mindfulness-based cognitive therapy programs, lasting six to eight weeks, on stress reduction, emotional regulation and coping skills, when delivered in the school setting (Zhao, 2025; Zhang et al., 2021a).

5.3.2. Effects on anxiety

Anxiety symptoms were higher at the post-intervention (T2) assessment, among adolescents who had participated in the mindfulness program, compared to the passive control group. However, these findings should be interpreted carefully. Higher baseline adjusted anxiety scores in the intervention group should not be interpreted as direct evidence that mindfulness training increased anxiety. Rather, an alternative interpretation suggests that emotional regulation did not keep pace with the increase in awareness capacity. Mindfulness possibly contributed to decentering and thereby increased awareness of internal distress before the capacity for emotional regulation had developed. Lucas-Thompson et al. (2023) investigated the effectiveness of the same mindfulness-based program as the one included in

the present study, Learning to BREATHE. The researchers examined differences in program effectiveness by comparing the function of mindfulness. Their findings suggest that adolescents were able to remain mindful even under stressful conditions (Lucas-Thompson et al., 2023). If similar effects occurred in this study, the post-intervention assessment would reflect a transition in which awareness of distress had increased but regulatory capacity had not yet developed sufficiently for the mindfulness training to have a fully beneficial effect on adolescent anxiety. Thus, further exploration of this mechanism is needed to fully explain the underlying processes.

Additionally, the under-regulated emotional capacity could reflect both inconsistencies in the mindfulness program effectiveness and developmental maturation and emotional dysregulation (Guyer et al., 2016). In fact, beneficial effects of MBIs on emotional regulation capacity are proposed for adolescents at risk, with evidence (Kuyken et al., 2022) suggesting that universal interventions do not necessarily translate into better short-term mental health outcomes.

5.3.3. Effects on frequency and belief in automatic thoughts

Finally, frequency and beliefs in automatic thoughts were included in the study as measures of underlying automatic mechanisms and habitual cognitive patterns. At the post-intervention (T2) assessment, no difference between groups was reported for the belief in observed automatic thoughts. However, adolescents in the intervention group reported a higher frequency of automatic thoughts, with the ANCOVA model suggesting a low to moderate effect. Although this pattern was not expected, the results should be considered from a broader cognitive perspective. Wells (1995) suggested that anxiety is maintained by positive beliefs about the utility of worry and negative beliefs about uncontrollability. It was proposed that mindfulness may reduce the influence of such metacognitive patterns by supporting decentring and disengaging from worry patterns, thus recovering attention capacity which, in turn, supports cognitive restructuring (Wells, 2006). In his model incorporating mindfulness and generalized anxiety disorder, Wells (2006) notes that disengaging from negative thoughts and attention training are core mindfulness mechanisms that might support more attentional and flexible metacognition patterns. At first glance, presented results suggest an unfavorable pattern and support the claim that self-focused mindfulness practices can contribute to dysfunctional beliefs (Wells, 2006). However, these results can be further interpreted. The higher frequency of automatic thoughts observed in the intervention group does not, in itself, indicate that the beliefs associated with these automatic thinking patterns have become more negative. Rather, this

result might suggest that adolescents who participate in the mindfulness-based training report observing more automatic thoughts than they did prior to the training. However, results concerning within group changes are hereby not tested, and are only commented at the descriptive level. Therefore, the specific time changes within the group should be tested in future studies to understand trajectories within the group level. This result further suggests that a cognitive shift in automatic processing has occurred, however, it was not strong enough to produce favorable effects in the context of appraisal. Future research should examine why this effect was produced and whether it was related to the amount of time adolescents engaged in personal mindfulness practice outside the formal program sessions. Furthermore, Wells (2006) noted that mindfulness involves “paying attention, on purpose, and in the present moment”. Thus, findings concerning the higher frequency of automatic thoughts reported among adolescents in the intervention group do not automatically suggest that the number of thoughts has increased, but rather that adolescents' attention capacity has shifted and decentered from habitual thinking, leading them to observe thoughts that were previously processed at an automatic, unconscious level. Although this result is contrary to the evidence that mindfulness reduces frequency of, or belief in, automatic negative thinking (Desrosiers et al., 2013), it suggests that a further exploration is needed to understand why cognitive patterns were only superficially shifted, and how can this metacognitive shift can be further supported through such interventions.

Considering the beliefs in automatic thoughts, findings suggest that the groups did not differ significantly at the post-intervention (T2) assessment. However, a significant, albeit small conditional effect for the belief in automatic thoughts was observed at the follow-up (T3) assessment. While the assumption of homogeneity was initially violated for this outcome, no group differences were reported, and this effect is considered baseline dependent, rather than an outcome of the mindfulness-based intervention.

5.3.4. Consistency of findings with recent evidence on MBIs effectiveness

Taken together, the findings concerning the preliminary effectiveness of the school-based mindfulness intervention for adolescents do not support the general benefit of this particular program. Rather, they suggest inconsistent and outcome specific effects. The presented results are consistent with recent evidence that universal SBMIs for adolescents produce small to negligible effects, especially considering the non-significant effects for follow-up assessments.

Accordingly, the findings on the SBMIs in Croatian adolescents are consistent with the results of the MYRIAD trial. The MYRIAD (My Resilience in Adolescence) cluster randomized controlled trial evaluated a universal school-based mindfulness training program based on the ".b" curriculum developed by the Mindfulness in Schools Project. The program was delivered to early adolescents (aged between 11 and 14 years) by classroom teachers over ten lessons and was compared with teaching-as-usual (Kuyken et al., 2022). Kuyken et al. (2022) found that universal mindfulness training was neither superior nor more beneficial than usual school education on mental health outcomes, despite its large scale implementation. Evidence from meta-analyses further supports null effects of universal MBIs for adolescents. Dunning et al. (2022) suggested that universal MBIs did not statistically improve trait mindfulness levels, or other mental health outcomes, including anxiety, stress, depression, and well-being, when compared to active control groups, such as included in the MYRIAD trial. Galla (2024) further showed that no significant effects are observed when MBIs are delivered only to adolescent sample. In their systematic review of 54 evaluation studies, Roeser et al. (2022) provided rationale for the inconsistent effectiveness of mindfulness-based programs. The authors argued that while mindfulness programs generally show promising effects primarily in improving mindfulness and self-regulation skills, and secondarily in reducing internalized distress second, the effectiveness of programs largely depend on the implementation quality and their fit with the targeted population. The results of this effectiveness study are therefore not surprising and reflect the common problem in universal delivery.

Universal vs. targeted delivery

Recent meta-analyses increasingly advocate for targeted rather than universal delivery of SBMIs. Arguments for this shift in perspective mostly lie in the findings that suggest targeted MBIs produce stronger effects on adolescent mental health outcomes, when compared to the universal programs (Kallapiran et al., 2015; Kuyken et al., 2022). Researchers argue that MBIs are more effective when delivered to adolescents who already experience initial distress and/or impairment in mental health, as such populations are also more motivated to engage with personal practice, which then strengthens mindfulness skills (Roeser et al., 2022). The sample included in Study 2 of this research represents the general population of adolescents, without significant outliers in mental health functioning at baseline. Galla (2024) notes that an important limitation of universal mindfulness programs relates to limited motivation to engage in meditation and personal practice among healthy adolescents. Thus, the program effectiveness

in the present study, possibly did not provide beneficial effects for two reasons. First, the problem (or distress levels) was insufficient to motivate the participants, and second, the potential for symptom reduction was limited because the problems had not reached a level at which measurable change could be detected. These findings further support the new direction of research on MBIs, which emphasizes the importance of mechanisms, and quality of implementation in the evaluation of SBMIs (Dunning et al., 2022; Galante et al., 2021; Montero-Marin et al., 2023; Roeser et al., 2022, 2023). Taken together, these findings are more in line with the feasibility perspective and provide valuable information on what aspects of SBMIs work and in what conditions (Roeser et al., 2022, 2023).

5.3.5. Importance of implementation factors for effectiveness findings

The inconsistent findings concerning the effectiveness study should be further interpreted through the perspective of implementation science, to understand why certain delivery conditions are more or less likely to produce favorable effects. Greenberg et al. (2001) reviewed 34 empirically evaluated prevention programs and proposed a set of principles that distinguish effective programs. These are further discussed in relation to the delivered SBMI.

First, the short-term nature of the Learning to BREATHE program explains why it showed limited impact, particularly in a universal adolescent sample where most participants do not report clinical-level difficulties. Greenberg et al. (2001) emphasize that short-term programs show limited benefits compared to the multi-year programs. While a short universal program may be sufficient to introduce the mindfulness concept and provide initial exposure to mindfulness practices, it is questionable whether it can be sufficient to produce beneficial effects and consolidate skills needed to alter stress processing or anxiety symptoms. Thus, the dosage constraint observed in this study, is aligned with the results of the MYRIAD trial on early adolescents (11 to 14 years) mentioned above (Montero-Marin et al., 2023) and further supported by Roeser et al. (2022, 2023) argument that personal practice is crucial to produce changes in the educable mindfulness skill.

Second, Greenberg et al. (2001) note that implementation quality and the quality of teacher training in mindfulness are significantly related to program outcomes. In the present study, implementation was constrained by the quasi-experimental design and by the constraints of school-based delivery, as noted later in the study limitations. School allocation was shaped primarily by readiness and feasibility rather than by individual randomization, all of which contributed to the implementation quality.

Finally, Roeser et al. (2022) emphasize the importance of student motivation and engagement with personal contemplative practice, which directly reflects program effectiveness. Evidence from the MYRIAD trial showed that mindfulness practice and student engagement varied considerably across students, and that this variability was central to understanding the limited effects that the program produced (Montero-Marín et al., 2023). The present results are consistent with these patterns and reflect low and inconsistent personal engagement with the provided mindfulness sessions. Even though the guided audio practices were provided to students after each program session, the reported engagement in personal practice at follow-up was almost non-existent and was limited to outlier students who were initially highly motivated to participate in the program — a pattern consistent with prior findings (Galla, 2024).

Therefore, the most defensible conclusion from Study 2 findings is not that mindfulness is irrelevant to the prevention of adolescent mental health, but rather that this brief universal school-based format did not produce the assumed benefits considering the examined outcomes in this adolescent sample.

6. HYPOTHESES VERIFICATION

Concise overview of the main findings of this dissertation is presented below through the verification of hypotheses. The general aim of this research was to determine the interrelationships between objective stressors, subjective stress and adolescent anxiety, while examining the protective role of mindfulness in these associations. Additionally, possible mechanisms of change of mindfulness on adolescent mental health have been tested by examining the effectiveness of a brief mindfulness-based intervention delivered in a school setting.

First and second research problems were addressed in the first study in this research and have considered the longitudinal associations between the selected variables.

Research problem 1. Determine the interrelationships between mindfulness, psychological stress, and anxiety in a sample of Croatian adolescents.

Hypothesis 1. There is a statistically significant correlation between mindfulness, psychological stress, and anxiety in adolescents.

Hypothesis 1a. There is a statistically significant negative correlation between mindfulness and psychological stress among adolescents.

Hypothesis 1b. There is a statistically significant negative correlation between mindfulness and anxiety in adolescents.

Hypothesis 1c. There is a statistically significant positive correlation between psychological stress and anxiety in adolescents.

The first research hypothesis was fully confirmed, as were the subsequent hypotheses (1a to 1c). The significant correlations between subjective stress, mindfulness and adolescent anxiety were established in this research. Significant moderate to high associations were shown in both baseline and follow-up assessments, respectively. Positive moderate to high correlations have been established between stress and adolescent anxiety at both time points, while negative moderate to high correlations have been established between mindfulness with both stress and adolescent anxiety, respectively.

Research problem 2. To empirically test the assumed model of interrelationships among stress, mindfulness, and anxiety in adolescents.

Hypothesis 2. The model in which objective stress, mediated by psychological stress, contributes to anxiety, while mindfulness, through both mediation and moderation in the relationship between objective stressors and psychological stress, reduces it, will be acceptable based on model fit indices.

Hypothesis 2a. Objective stress significantly contributes to explaining anxiety both directly and indirectly through psychological stress.

Hypothesis 2b. Mindfulness significantly contributes to lower levels of psychological stress in the presence of objective stress.

Hypothesis 2c. Psychological stress significantly contributes to an increase in anxiety directly.

Hypothesis 2d. Mindfulness significantly contributes to reducing anxiety both directly and indirectly through psychological stress.

The second research hypothesis was fully confirmed, as were the subsequent hypotheses (2a to 2d). Overall, the data supported the hypothesized moderated mediation model. Objective stressors significantly and positively contributed to later anxiety, both directly and indirectly through subjective stress. The moderating role of mindfulness onto the relationship between objective stressors and subjective stress was significant and negative. Although small in effect, this result suggested that the effect of exposure of objective stressors on subjective stress and later anxiety depended on individual mindfulness levels. The relationship between objective stressors and subjective stress was attenuated by mindfulness, positioning mindfulness as a buffer in the hypothesized sensitization pathway. Subjective stress significantly and positively contributed to later adolescent anxiety, suggesting that prior stress appraisal increased later anxiety levels. Additionally, the paths from mindfulness to later anxiety and stress were also significant. Mindfulness significantly and negatively contributed to later anxiety. This moderate effect was both direct, and indirect, mediated by subjective stress. The confirmed mediating path suggests that mindfulness operates not only as a buffer in stress appraisal, but also as a direct protective factor that reduces the downstream effect of stress on later anxiety.

Third research problem focused on the effectiveness study of a mindfulness-based intervention, examining both short- and long-term effectiveness.

Research problem 3. Evaluate the effect of mindfulness-based intervention on the perception of stress and adolescent mental health.

Hypothesis 3. Levels of mindfulness, psychological stress, anxiety, mental well-being, and strength and belief in automatic thoughts significantly differ between the intervention and control groups after the intervention.

Hypothesis 3a. The level of mindfulness is significantly higher in the intervention group after the intervention compared to the control group.

Hypothesis 3b. The level of psychological stress is significantly lower in the intervention group after the intervention compared to the control group.

Hypothesis 3c. The level of anxiety is significantly lower in the intervention group after the intervention compared to the control group.

Hypothesis 3d. The level of mental well-being is significantly higher in the intervention group after the intervention compared to the control group.

Hypothesis 3e. The strength of belief in automatic thoughts is significantly lower in the intervention group after the intervention compared to the control group.

Hypothesis 3f. The frequency of automatic thoughts is significantly lower in the intervention group after the intervention compared to the control group.

The third research hypothesis was not confirmed. Accordingly, none of the subsequent hypotheses (3a to 3f) that assumed specific group differences were confirmed. Regarding short-term effectiveness, significant differences were shown between the intervention and control groups in levels of mental well-being, anxiety, and frequency of automatic thoughts. However, the results rather suggested an inverse outcome than expected. Higher levels of mental well-being were reported by the control group, while the intervention group reported higher levels of both anxiety and frequency of automatic thoughts at the post-intervention assessment (T2). Regarding long term effectiveness, no group differences were reported in the observed mental health variables at follow-up (T3). Significant group differences were reported for the belief in automatic thoughts. However, group specific analysis was not obtained as the analysis assumption was violated for this variable.

7. LIMITATIONS AND FUTURE DIRECTIONS

The aim of this research was to examine the role of mindfulness in adolescent mental health, by testing the empirical model on longitudinal data, and examining the preliminary effectiveness of a mindfulness-based intervention. This is one of the first studies to examine this process model in the adolescent population in Croatia, while also combining this approach with intervention effectiveness. Although the research encompassed in this dissertation provides valuable knowledge on how mindfulness operates as a preventive factor in adolescent mental health, the findings should be interpreted within several limitations. The research program included two studies employing different methodological designs. Consequently, their respective limitations suggest divergent avenues for future research. The limitations are therefore considered separately for each study.

7.1. Limitations of STUDY 1. Longitudinal study

The first limitation of Study 1 concerns the measurement method of objective stressors. Exposure to stressful life events was treated as the count of total exposure and used as a measure of objective stress at baseline. While the goal was to conceptually distinguish between the stressor exposure and stress appraisal, using this occurrence-based method was appropriate. However, omitting the severity count out of stressful life events, possibly restricted the proportion of explained variance in the tested model, then compared to severity-based method. Milas et al. (2023) suggest that simultaneous use of both occurrence- and severity-based method of stressful life events should be used in self-report stress measures.

The main limitation of Study 1 lies in the two-wave longitudinal design. Even though examining associations between variables from two measurement waves makes for a methodologically stronger research design compared to cross-sectional studies (Cole & Maxwell, 2003), this approach remains limited compared to full longitudinal designs that include more assessment waves. Including three-wave assessments, instead of the two-wave design, allows researchers to draw more rigorous conclusions regarding causality between variables, beyond establishing their directionality (Hayes, 2002). This is especially important considering developmental trajectories and the pathways examined here. Additionally, including more than two assessment points is relevant for the mediation analysis, which was an integral part of the conceptual model tested in this dissertation. Methodological scholars (Cole & Maxwell, 2003; Maxwell & Cole, 2007) note that at least three measurement occasions are needed to adequately assess the directional relationships in a mediation model and to allow

stronger conclusions. Moreover, autoregressive paths were omitted in the final model version due to its poor fit to the two-wave data. Because autoregressive paths were omitted, we cannot draw firm conclusions about the relationship between mindfulness, stress and adolescent anxiety, beyond the contribution of baseline anxiety levels. Thus, future research focusing on broader model testing should apply more rigorous designs and include additional data collection waves. This would allow for comparisons of bi-directional paths, thus allowing the researcher to make broader conclusions on the interplay between considered variables.

A further limitation concerns the timing interval between the two assessment waves. The six-month interval may have been too narrow to capture longer-term stress sensitization processes (Stroud, 2020) or meaningful within-person change in trait mindfulness, both of which typically unfold over longer developmental windows. At the same time, the six-month interval was too wide to capture short-term affective and stress fluctuations that are characteristic of adolescence, which may occur on a daily or weekly basis. Future longitudinal research could combine these two perspectives by using longer follow-up windows in combination with intensive shorter-interval assessments (e.g., experience sampling or daily diary methods), thus capturing both developmental processes and shorter-term daily mood fluctuations.

Finally, manifest variables were used throughout Study 1, including in testing the conceptual model. While this approach is common in modelling interaction effects such as those examined in this research, and provides benefits regarding model replication, the use of composite scores does not separate the variance from measurement error (Field et al., 2012; Kline, 2023). Although the risk of measurement error was significantly reduced as all measures showing high reliability, future studies would benefit from employing latent variable modelling. Examining the associations between variables from a latent perspective would be especially beneficial when working with constructs that conceptually overlap (Field et al., 2012; Kline, 2023), such as various mental health outcomes and mindfulness.

A limitation relevant to both studies

Considering construct overlap and measurement errors, a limitation of both Study 1 and Study 2, is the reliance on adolescents' self-report measures. This is particularly relevant when measuring mindfulness. Although the CAMM was developed as a developmentally appropriate

measure of mindfulness (Greco et al., 2011), and has shown satisfactory psychometric properties in the Croatian sample, the validity of assessing mindfulness through self-reports remains an ongoing methodological question (Baer, 2008). Bear (2008) notes that the quality of measuring mindfulness through self-reports might vary based on the individual differences in familiarity with contemplative practices and level of introspection. This consideration is particularly important, as metacognitive processes (Fuhrmann et al., 2015; Paus et al., 2008), and thus mindfulness, are still undergoing development during adolescence. In this context, applying latent rather than manifest modelling is especially beneficial in reducing measurement error. Therefore, the presented mindfulness findings should be interpreted accordingly.

A sample-related limitation that applies to both studies in this dissertation concerns the geographic restriction of the sampling. Participants in both the longitudinal Study 1 and the quasi-experimental Study 2 were recruited from secondary schools in the Zagreb area. The findings therefore reflect adolescents from urban schools in this region, and generalizability to adolescents in other regions of Croatia, should be tested in future research with broader geographic recruitment.

7.2. Limitations of STUDY 2. Quasi-experimental effectiveness study

It is important to note that Study 2 was designed primarily to evaluate the preliminary effectiveness of the Learning to BREATHE program, rather than to evaluate its implementation. While implementation factors are considered throughout discussion and this section because they directly inform the interpretation of the effectiveness findings, a systematic implementation evaluation, including formal fidelity measurement, dosage tracking, and engagement metrics, falls outside the scope of the present study. The limitations discussed below should therefore be considered as both methodological constraints and as directions for future research, which would benefit from a future implementation study conducted in parallel with effectiveness testing.

The first important limitation in Study 2, concerns its methodological design. The quasi-experimental effectiveness study was designed as a quasi-experimental design, meaning that the research design lacked in randomization compared to true experimental design. This subsequently reduced its internal validity (Milas, 2005). Randomized control trials (*RCTs*) are often considered the gold standard in testing intervention effectiveness (Kuyken et al., 2022). Although the experimental design is methodologically superior to a quasi-experimental one, applying a full experimental design was impractical within the real-world school setting in

which this intervention was delivered. Nonetheless, close attention was paid to the selection criteria of schools included in the study. Schools were selected from a broader pool and were comparable in main curriculum orientation and student profile (gender and GPA) to minimize contextual confounding factors. However, causal conclusions regarding the observed differences cannot be definitively drawn due to limitations in the study design. Therefore, a randomized controlled trial or similar experimental design, including a larger sample of schools, should be used in the future research when testing mindfulness-based intervention effectiveness.

The second limitation of Study 2 concerns the feasibility constraints and delivery conditions (Greenberg et al., 2001) of the Learning to BREATHE program. While the program was delivered within the constraints of the school setting, the sessions had to be shortened to fit the usual class format, lasting only 45 minutes long. Although the program was adapted in line with prevention standards, and care was taken to preserve the core practices in the Croatian form, this shortened format possibly reduced the available time for deeper integration of formal mindfulness practices. Shortening the length of the sessions was a necessary but non-optimal adaptation considering the implementation from a pedagogical perspective. Therefore, future research should examine the effectiveness of full-length sessions compared to shortened versions, to better understand which format is best suited for both the school setting and optimal effects.

Possibly the most important limitation to Study 2, alongside the short delivery, and one which is reflected in the null findings, is the content of the program. It is important to note that the L2B program is not solely focused on mindfulness skills training but rather combines aspects of mindfulness with socio-emotional learning skills and emotional regulation. Because socio-emotional learning skills take longer to consolidate, and as mindfulness, require sustained personal practice, these two aspects largely contributed to the (in)effectiveness of the program. Therefore, future studies should implement longer variants of the same program but also examine the effectiveness of MBCT and/or MBSR based programs in this population, to provide a more comprehensive understanding of what type of programs and under which delivery conditions provides optimal effects on mental health in Croatian adolescents.

Finally, several implementation factors should be mentioned within the Study 2 limitations. The program was delivered with the same content across classes, with the same facilitator leading the delivery. However, some adaptations in the delivery form were necessary

depending on the class characteristics in order to support student engagement. Additionally, a second facilitator was present in two out of five classes. Finally, while the assessment questionnaires included measures of student motivation, familiarity with mindfulness practices, satisfaction with the overall delivery and experience of participating in the program, fidelity was not separately tested as part of this research. While this is not unusual in school-based effectiveness research, it should be noted as a study limitation. As emphasized at the beginning of this section, future research should ideally include a dedicated implementation and fidelity study conducted in parallel with effectiveness testing, to provide a more complete picture of how, for whom, and under what conditions mindfulness-based programs work in the Croatian school context.

8. CONTRIBUTIONS

This dissertation contributes to the literature on adolescent mental health, focusing on mindfulness, stress, and anxiety prevention and mental health promotion. Recent reviews and meta-analyses suggest that this research field lacks in understanding of the underlying mechanisms of adolescents mental health, while also needs more rigorous longitudinal research designs and evidence of school-based mindfulness interventions (Dunning et al., 2019, 2022; Fulambarkar et al., 2023; Galla et al., 2024). Therefore, the contributions presented below are closely related to the observed research gaps that this research aimed to address. Lastly, contributions to the field of prevention science are acknowledged.

8.1. Theoretical contributions

The core theoretical contribution of this research lies in the integration of mindfulness, with the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984, 2004), and stress sensitization model (Stroud, 2020) within a broader model of adolescent anxiety. Although the role of mindfulness in mental health outcomes has been established, at the correlational level (Dunning et al., 2019; Broderick & Metz, 2009), the research presented in this dissertation does not consider anxiety as an isolated symptom, nor mindfulness as a general correlate of mental well-being. Rather, it positions mindfulness at specific points in the stress–anxiety pathway. Within the examined model, mindfulness was integrated according to Garland's (2009, 2015b) Mindfulness-to-Meaning Theory and Creswell and Lindsay's (2014) mindfulness stress buffering account, and considered in the mental health process as both a protective factor and a buffering agent. The proposed role of mindfulness in this specific pathway is especially important considering that the mindfulness literature provides more evidence on whether mindfulness is merely associated with specific outcomes, rather than suggests how mindfulness operates related to stress processes (Dunning et al., 2019; Goodman et al., 2017). Therefore, this broader model was supported by the data and provides a more comprehensive understanding of the role of mindfulness in adolescent mental health. Findings suggest a possible dual role, in which mindfulness acts both as a buffer that attenuates the stress sensitization mechanism and as a protective factor with a downstream effect on later anxiety. Therefore, mindfulness identifies a process through which stress appraisal pathways can be modified. Finally, the integration of these three frameworks in a single model provides a developmental understanding of how stress contributes to anxiety, and where preventive interventions can change the process trajectories.

Another theoretical contribution concerns the conceptualization of stress. This research encompassed two of three contemporary stress conceptualizations (Slavich, 2016). Objective stress(ors) were conceptualized as a total count of stressful life events, while subjective stress was examined as stress appraisal. This distinction is important while newer stress theorists (Slavich, 2016; Slavich & Shields, 2018) emphasize that stressful events and the experience of stress are not the same construct and thus should not be measured as one. This conceptualization is also in line with Milas et al. (2023), who argued that stressful life events and subjective stress should not be treated as interchangeable variables, while they reflect distinct levels in the stress process. By examining both stressful life events and stress appraisal, this research contributed evidence that a precise conceptualization of stress benefits the understanding of specific underlying pathways in mental health research. Thus, modelling the two stress constructs separately and examining them within the same framework with mindfulness supports theoretical hypothesis about underlying stress mechanisms. Finally, this contribution translates into (future) research designs and methodological implications.

8.2. Methodological contributions

The primary methodological contribution of this dissertation lies in combining two complementary research studies and designs. Study 1 examined the proposed associations between constructs and tested the conceptual model of mindfulness, stress and adolescent anxiety using longitudinal modelling. Study 2 evaluated the effectiveness of a school-based mindfulness intervention using a quasi-experimental design.

In combining two methodological designs, this research provided a comprehensive understanding not only of the temporal associations between the variables but also examined short- and long-term intervention effects and possible mechanisms of change (such as automatic thoughts) through which mindfulness operates. This approach directly addressed limitations in adolescent mindfulness research, which mostly reflects correlational evidence without process modelling (Maxwell & Cole, 2007). This complementary design contributes to the methodology of the field.

Considering methodological contributions separately by studies, Study 1 contributed to the field by establishing temporal associations between variables using longitudinal modelling. Thus, the relationship between mindfulness, stress, and adolescent anxiety was considered beyond the cross-sectional perspective. Although the two-wave study reflects limitations when compared to multiple waves, this approach provided a stronger insight into the relationships

between the considered constructs. By proposing temporal ordering between stressful life events, subjective stress, mindfulness, and later anxiety, this study also addressed the measurement gap in assessment of stress as two distinctive measures, rather than same construct, aligned with recent research on adolescent stress (Milas et al., 2023).

Study 2 contributed through its ecological validity, reflecting a real-world setting. The effectiveness of the intervention was examined within the educational setting and school conditions with the usual class schedule. Although this constraint was reflected in the duration of program sessions and classroom delivery, recent reviews of mindfulness-based interventions (Dunning et al., 2022; Fulambarkar et al., 2023; Galla et al., 2024) note that the field lacks evidence on more realistic program implementation. Accordingly, Study 2 contributed to the understanding of effectiveness and feasibility of the intervention under usual school conditions, rather than a fully controlled experimental setting. This contribution is valuable from a prevention perspective, as it provides evidence on feasibility and future implementation research.

Lastly, the measurement of mindfulness was noted in the research limitations. However, this research assessed mindfulness using the Child and Adolescent Mindfulness Measure (CAMM) (Greco et al., 2011). While the author of this instrument has noted the complexity of measuring mindfulness using self-report measures in a younger population, the use of this measure is methodologically important for two reasons. First, this instrument is a developmentally appropriate mindfulness measure and has been developed to assess mindfulness specifically in children and adolescents (Greco et al., 2011). Although this only partially reduces the question of measurement error, the developmentally appropriate nature of this measure addresses research gaps concerning the assessment of adolescent mindfulness using measures developed for the general population (Goodman et al., 2017). Second, this research represents one of the first studies in which the Child and Adolescent Mindfulness Measure (Greco et al., 2011) was used with Croatian adolescents, thus providing a cross-cultural methodological contribution.

8.3. Empirical contributions

The empirical contributions of this research are considered separately for Study 1 and Study 2, due to differences in study designs.

Valuable empirical contribution of Study 1 lies in the evidence that mindfulness is related to later adolescent anxiety, as established through structural equation modelling. Study 1 associated mindfulness with lower subjective stress and lower later anxiety. The empirical model showed a strong fit with the data, indicating that mindfulness largely shapes how adolescents respond to stress appraisal. This is an important empirical contribution to the research field providing insight into relationships between mindfulness, stress, and adolescent anxiety beyond mere associations between variables. Rather, it provides evidence for a comprehensive understanding of the mechanisms that shape the stress process and direct mental health trajectories. Moreover, by modelling objective and subjective stress as distinct constructs, Study 1 supported the claims for a more precise assessment of stress in adolescent mental health.

Study 2 contributed to the empirical evidence on the feasibility and effectiveness of a brief school-based mindfulness intervention. Results showed almost no significant difference between control and intervention groups across all assessed mental health outcomes, when the program is delivered under the constraints of the school setting. Subjective stress and mindfulness did not differ between groups, while mental well-being, anxiety and automatic thoughts showed an unfavorable trend. Although unexpected, these results are in line with recent literature suggesting that school-based mindfulness programs do not always yield (strong) effects (Dunning et al., 2022; Fulambarkar et al., 2023; Galla et al., 2024; Kuyken et al., 2022). These empirical findings suggest that the universality claim of school-based interventions should be carefully considered, as the effectiveness of the intervention might be determined by contextual constraints and feasibility. Based on the findings, the program delivered in Study 2 was possibly insufficient in dose and content to alter the appraisal process suggested by the empirical model. Thus, the results from this effectiveness study imply that the effectiveness of some mindfulness-based interventions might depend on dosage, delivery conditions, and participants' engagement, and such aspects should be further considered in future implementation research.

Finally, the empirical contribution of this dissertation is reflected in the evidence on the relationship between mindfulness, stress, and mental health from Croatian adolescents. The

majority of mindfulness-focused research has been carried out in the international context, especially with regard to school-based prevention research (Kuyken et al., 2022; Dunning et al., 2022). Therefore, this dissertation represents one of the first quasi-experimental evaluations of a mindfulness-based curriculum with high-school students in Croatia, thus extending the evidence on school-based mindfulness programs.

8.4. Scientific contributions to prevention science

The final contribution of the overall research presented here lies in its relevance to prevention science. From this perspective, this dissertation provides an understanding of the relationships between mindfulness, stress and anxiety beyond the symptom level. Rather, these interrelationships are considered within a broader process framework that considers risk and protective factors, and integrates school-based prevention (Greenberg, 2004; Greenberg & Domitrovich, 2004; Greenberg et al., 2001; Bašić, 2009).

Risk factors are often the focus of prevention research, as they significantly contribute to negative mental health outcomes. However, protective factors, such as mindfulness, both attenuate the effect of risk factors and directly contribute to mental health outcomes (Bašić, 2009). Therefore, the rationale of this dissertation is aligned with core prevention principles, which understand mental health outcomes as a function of the dynamic interplay between risk and protective factors. Both early identification of protective factors and an understanding of the underlying mechanisms and processes through which they contribute to mental health provide valuable information for the development of feasible preventive (and promotion) actions (Greenberg et al., 2001). This is especially relevant for developmentally challenging periods, such as adolescence. The identification of risk and protective factors during adolescence is an important step in identifying adolescents at higher risk for developing mental health problems. Literature in this field considers stress, especially exposure to adversity, as a risk factor that precedes poor mental health outcomes (Epel et al., 2018; Rapee et al., 2009) and moderates future health trajectories (Stroud, 2020). Simultaneously, mindfulness is consistently shown to be a protective factor for youth mental health. Rajan et al. (2026) provided a review on the scope of studies that examined the effectiveness of mindfulness-based interventions on stress reduction and noted that the potential of these interventions lies in mindfulness's ability to modify processes that shape adaptation to adversity.

Specifically, the presented results contribute to the prevention field in two ways. First, the empirical model contributes to the understanding of how adversity, stress appraisal, and

mindfulness are related to later anxiety. This is an important finding that provides evidence for the identification of processes and mechanisms that precede later anxiety in adolescence and may provide valuable evidence for selective or targeted interventions (Greenberg et al., 2001; Greenberg & Domitrovich, 2004). Second, Study 2 contributes to prevention practice and provides valuable evidence on school-based program effectiveness. Domitrovich et al. (2008) note that the value of preventive interventions lies not only in program effectiveness, but also in feasible implementation, alongside relevance within the broader system. Therefore, considering program effectiveness alongside the constraints under which the intervention was delivered provides valuable information for future implementation research and preventive practice in the Croatian context. This is particularly relevant given the absence of prior systematic evaluations of mindfulness-based programs for adolescents in Croatia, and positions the present study as a starting point for future implementation research that can build on the effectiveness findings reported here.

9. IMPLICATIONS FOR MENTAL HEALTH PROMOTION AND PREVENTIVE ACTIONS

The findings of this dissertation have direct implications for adolescent mental health strategy, particularly in the Croatian context. Anxiety is among the most common mental health problems in Croatian youth (Milas et al., 2025b), and population-level data indicate that a substantial proportion of adolescents report clinically significant symptom levels. However, the scale of this problem is not matched by the policy response. Novak and Petek (2015) argued that Croatian mental health policy has focused narrowly on the treatment of clinical disorders, while both promotion and prevention have been systematically overlooked. They identified the lack of intersectoral coordination, absent action plans, and a passive professional role as core systemic problems, and proposed a multisectoral approach to address these problems (Petek et al., 2017). Almost a decade later, the situation has not substantially changed. The strategic framework for mental health protection adopted in the post-pandemic period (Government RH, 2022) identified promotion, prevention, and early intervention as important preventive goals. However, this framework has not been translated into specific public policies targeting adolescent mental health. Therefore, a national strategy for youth mental health remains non-existent in Croatia, more than ten years after researchers first argued its necessity.

The present findings contribute to the policy discussion from a translational perspective. Study 1 demonstrated that adolescent anxiety is not a direct product of stress exposure alone. Rather, it emerges through subjective stress as a mediating process, and trait mindfulness buffers the translation of stressful life events into subjective stress burden. This finding is consistent with both the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) and the stress sensitization model (Stroud, 2020), and it supports the conceptual distinction between stressor exposure and stress appraisal that contemporary stress research has called for (Slavich, 2016; Slavich & Shields, 2018). These findings have a clear implication for preventive design, where interventions targeting adolescent anxiety should not focus solely on reducing exposure to stressors. Rather, they should target the appraisal and regulatory processes through which stress becomes psychologically harmful. Mindfulness is one such regulatory mechanism, but it is not the only one. Cognitive reappraisal, emotion regulation skills, social support, and metacognitive awareness represent additional pathways that could be integrated into preventive programming. Wells' (1995, 2006) metacognitive model further indicates that positive beliefs about worry and negative beliefs about uncontrollability are central to the maintenance of generalized anxiety, and these beliefs represent clear targets for preventive intervention. The

model therefore argues for a process based approach to prevention. The selection of intervention components should therefore be guided by empirical evidence about which processes link risk factors to outcomes, rather than by the availability of a particular preventive program. This approach is aligned with principles of effective prevention programming, which require targeting empirically established risk and protective factors and operating through specific process mechanisms (Greenberg et al., 2001).

Study 2, however, demonstrated that translating this process based approach into brief universal school-based delivery is difficult. As discussed in this dissertation, the Learning to BREATHE program did not produce significant improvements in mindfulness, stress, or anxiety under the implementation conditions of this study. The discussion attributed this to dosage, student engagement, and contextual constraints (Greenberg et al., 2001). The six-session format, which was necessary to fit with the Croatian school timetable, was likely insufficient for the consolidation skills that the Learning to BREATHE curriculum addresses. Student engagement with personal practice and the absence of motivational factors to support sustained engagement further constrains the impact of universal delivery (Galla, 2024). The implication for mental health policy is therefore not that school-based mental health interventions should be abandoned. Rather, the form of their delivery should be further examined. Brief universal mindfulness programs, delivered as standalone components without systemic support, do not appear sufficient to prevent anxiety in adolescent population. This conclusion is consistent with the broader evidence from large-scale trials (Kuyken et al., 2022) and meta-analyses (Dunning et al., 2022; Galla, 2024).

Two directions for policy and preventive practice are therefore suggested. First, these findings support the case for mental health promotion rather than universal prevention. Promotion strategies aim to strengthen protective capacities across the general population without requiring that participants meet clinical thresholds. In the present model, mindfulness functions as a protective factor that operates at the trait level. Although, a brief program did not improve mindfulness scores at group level in this sample, this does not mean that promoting mindfulness skills through broader educational and developmental strategies is without value. Roeser et al. (2022) emphasize that mindfulness can be understood not only as a natural mental state and an enduring trait, but also as an educable skill, and development of this skill depends on sustained engagement with practice and supportive implementation conditions. Mental health promotion embedded within existing school curricula, and school climate initiatives for supporting mindfulness training represents a more sustainable approach than standalone

program delivery. Keyes' (2002) dual continuum model supports this perspective. Mental health is not merely the absence of psychopathology but also includes the presence of flourishing. Therefore, the promotional actions that strengthen well-being, regulatory capacity, and coping skills across may contribute to adolescent mental health even when they do not produce measurable reductions in anxiety symptoms. The developmental window of adolescence further supports this approach, as neuroplasticity during this period creates opportunities for the consolidation of socio-emotional skills that may shape future mental health trajectories (Fuhrmann et al., 2015).

Second, these findings support the case for targeted intervention alongside universal promotion. The meta-analytic evidence reviewed in this thesis indicates that targeted mindfulness-based interventions, delivered to adolescents who are already experiencing elevated stress, tend to produce stronger effects than universal programs (Helminen et al., 2022; Kallapiran et al., 2015; Kuyken et al., 2022). This is consistent with the stress buffering model tested in Study 1 and with the broader mindfulness stress buffering account (Creswell & Lindsay, 2014). Accordingly, the protective function of mindfulness may be most prominent under conditions of high stress, and interventions may therefore be most effective when they are delivered to adolescents at risk. Therefore, the universal mental health promotion could be embedded within the educational system to support socio-emotional competence and stress coping, while targeted interventions should be directed toward adolescents at risk. This suggestion reflects the developmental concern that adolescents who do not perceive personal relevance, may not engage with the program (Galla, 2024; Montero-Marin et al., 2023).

Regarding state of adolescent mental health in Croatia, the absence of a national mental health strategy remains the main issue. This prerequisite is crucial for the coordination of the universal promotional and preventive actions across the broader system. Schools lack systematic frameworks for mental health promotion, while practitioners lack training in evidence-based preventive delivery. Referral pathways between school-based identification and clinical treatment are also unsupported. The present findings, therefore, argue that addressing adolescent anxiety in Croatia requires more than the adoption of individual programs. Rather, it requires systemic support and change in the conditions that make programs effective and sustained. However, without policy changes, a national strategy that considers adolescent mental health as a public health priority will stay overlooked.

10. CONCLUSION

The aim of this research was to explore the relationship between exposure to objective stressors and psychological or subjective stress, mindfulness, and anxiety among adolescents, and to examine the effect of mindfulness-based intervention on adolescents' perception of stress and mental health. Theoretical foundations for this research combined Transactional Model of Stress and Coping (Lazarus & Folkman, 1984) with stress sensitization model (Stroud, 2020) and proposed a broader stress processing framework. To examine the role of mindfulness in the proposed stress-anxiety pathways, mindfulness was incorporated into the integrated process framework, based on the Mindfulness-to-Meaning Theory (Garland, 2015) and Mindfulness Stress Buffering Account (Creswell & Lindsay, 2014). The dual role of mindfulness on adolescent stress and later anxiety was examined by testing the empirical model of those interrelationships. Finally, the proposed mechanisms were further examined through the effectiveness of a school-based mindfulness intervention for adolescents.

Empirical model tested in Study 1 confirmed both stress processing mechanisms and the dual role of mindfulness in stress-anxiety pathways. Stress sensitization mechanism was confirmed, with objective stress contributing to later anxiety in adolescents, both directly and indirectly, through stress appraisal. Albeit small in effect, a moderating role of mindfulness was confirmed in the sensitization pathway, suggesting that mindfulness buffers the effect of stressful life events in the stress appraisal, thus reducing adolescent sensitivity to stressors. Furthermore, a protective role of mindfulness to later anxiety was also established. Mindfulness was associated with later adolescent anxiety both directly and indirectly by lowering subjective stress. Results of the effectiveness study (Study 2), however, do not support the claim that universal school-based mindfulness interventions have substantial effect on adolescent mental health, as delivered in the form in this study. No significant effects have been reported for mindfulness and stress between groups. However, a negative trend in changes in anxiety, automatic thoughts and mental well-being has been noticed considering short-term intervention effects. No significant changes have been reported in primary outcomes at the three months follow-up.

Taken together, these findings suggest that mindfulness shapes stress appraisal and also acts as a protective mechanism to mental health by reducing downstream effect of stress. However, these observed pathways have not been reproduced by mindfulness-based interventions. Rather, the effectiveness findings are more in line with the feasibility perspective

and provide guidelines for future effectiveness and implementation studies on school-based mindfulness interventions. Finally, this dissertation reflects the importance for a comprehensive and nationally broad assessment of adolescent mental health that would translate to developmentally timely and appropriate promotional and preventive actions, which are largely neglected considering Croatian youth mental health.

11. LITERATURE

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12. APPENDIX

Table 1a.

Descriptive statistics of variables included in the longitudinal study

		M	SD	Min.	Max.	IS	IK	Valid N	Reliability (Alpha)
Mindfulness	CAMM wave 1	2.24	0.83	0	4	0.03	-0.6	856	.86
	CAMM wave 2	2.22	0.83	0	4	0.05	-0.43	922	.87
Objective stress	SLEs exposure count	13.03	7.58	0	46	1.24	1.74	722	N/A
Subjective stress	Subjective stress TOTAL wave 1	2.23	0.83	1	5	0.59	-0.42	855	.92
	School problems	2.36	0.97	1	5	0.53	-0.44		.71
	Future-oriented stress	2.53	1.23	1	5	0.47	-0.89		.84
	Parents-related stress	2.13	1.09	1	5	0.89	-0.13		.80
	Friends-related stress	2.08	1.12	1	5	0.94	-0.13		.81
	Relationship problems	1.83	0.94	1	5	1.19	0.79		.69
	Self-related stress	2.46	1.13	1	5	0.48	-0.74		.77
	Subjective stress TOTAL wave 2	2.31	0.83	1	5	0.39	-0.47	923	.92
	School problems	2.44	0.96	1	5	0.28	-0.75		.74
	Future-oriented stress	2.71	1.25	1	5	0.18	-1.16		.87
	Parents-related stress	2.21	1.09	1	5	0.69	-0.52		.82
	Friends-related stress	2.1	1.1	1	5	0.85	-0.28		.81
	Relationship problems	1.92	0.93	1	5	0.99	0.48		.68
	Self-related stress	2.5	1.11	1	5	0.38	-0.79		.76
Anxiety	GAD wave 1	1.07	0.78	0	3	0.57	-0.54	855	.89
	GAD wave 2	0.95	0.76	0	3	0.72	-0.19	923	.89

Note. Reliability for SLE exposure count is not calculated while separate stressful life events are not necessarily expected to be intercorrelate

Table 2a.*Descriptive statistics for variables included in the effectiveness study.*

	N	Min	Max	M	SD	Skew.	Kurt.
cammm_v1	199	0.00	4.00	2.16	0.89	-0.24	-0.19
cammm_v2	199	0.00	3.90	2.09	0.83	-0.08	-0.38
cammm_v3	172	0.30	3.90	2.25	0.79	-0.16	-0.52
pq_v1	199	1.00	4.44	2.27	0.61	0.44	0.57
pq_v2	200	1.06	4.11	2.33	0.66	0.40	-0.28
pq_v3	174	1.11	4.00	2.28	0.63	0.32	-0.47
gad_v1	199	0.00	3.00	1.26	0.77	0.42	-0.53
gad_v2	200	0.00	3.00	1.21	0.76	0.56	-0.51
gad_v3	174	0.00	3.00	1.16	0.75	0.65	-0.09
mz_v1	195	1.00	4.93	3.41	0.70	-0.21	0.19
mz_v2	200	1.36	5.00	3.44	0.67	0.05	-0.22
mz_v3	172	1.64	5.00	3.52	0.63	0.17	-0.23
atm_ucest_v1	197	1.00	5.00	2.07	0.99	1.12	0.46
atm_ucest_v2	199	1.00	4.60	2.19	0.95	0.64	-0.67
atm_ucest_v3	172	1.00	4.93	1.95	0.90	1.08	0.52
atm_vjera_v1	190	1.00	5.00	2.16	0.98	0.94	0.21
atm_vjera_v2	198	1.00	5.20	2.25	1.06	0.86	0.19
atm_vjera_v3	168	1.00	5.00	2.03	0.99	1.06	0.50

Note. Supplementary table for ANCOVA analysis

Table 3a.*Linear correlations among baseline and post-intervention outcome variables included in effectiveness study*

	1	2	3	4	5	6	7	8	9	10	11	12
camm_v1	1	.79	-.59	-.53	-.68	-.54	.54	.52	-.60	-.66	-.57	-.63
camm_v2		1	-.49	-.62	-.55	-.61	.47	.53	-.51	-.66	-.51	-.65
pq_v1			1	.75	.67	.48	-.56	-.57	.63	.63	.58	.57
pq_v2				1	.56	.63	-.58	-.60	.57	.65	.57	.57
gad_v1					1	.67	-.54	-.53	.70	.66	.60	.54
gad_v2						1	-.44	-.53	.55	.69	.49	.53
mz_v1							1	.75	-.64	-.60	-.55	-.48
mz_v2								1	-.53	-.68	-.58	-.62
atm_ucest_v1									1	.79	.83	.62
atm_ucest_v2										1	.73	.77
atm_vjera_v1											1	.76
atm_vjera_v2												1

Note. All correlations are significant at $p < .001^{***}$; Supplementary table for ANCOVA assumptions

Supplementary Material 1.

Motivation and expectations questionnaire administered at baseline (Study 2)

Kroz idućih nekoliko tjedana sudjelovati ćeš u programu utemeljenom na *mindfulness* treningu. Trening ćemo izvoditi zajedno, u grupi, a ti ćeš imati priliku nakon svakog susreta primjenjivati naučene tehnike individualno, u vrijeme kada tebi odgovara, te kada to poželiš i za time budeš imao/la potrebu. Nakon što si detaljnije upoznat/a s *mindfulness*-om, time kako *mindfulness* trening izgleda i što ćemo radi molimo te da odgovoriš na nekoliko pitanja.

Molimo te za svako pitanje označi koliko se slažeš sa tvrdnjom, pritom se vodeći slijedećom skalom:

1 = uopće se ne slažem; 3 = niti se slažem, niti se ne slažem; 5 = potpuno se slažem

	(1) Uopće se ne slažem	(2) Uglavnom se ne slažem	(3) Niti se slažem, niti se ne slažem	(4) Uglavnom se slažem	(5) Potpuno se slažem
<i>Mindfulness</i> trening će mi olakšati suočavanje u teškim ili stresnim situacijama.	1	2	3	4	5
Vjerujem da ću općenito imati koristi od <i>mindfulness</i> treninga.	1	2	3	4	5
<i>Mindfulness</i> mi može pomoći da se umirim u situacijama koje mi uobičajeno stvaraju stres ili u kojima osjećam napetost ili tjeskobu.	1	2	3	4	5
Vjerujem da će mi <i>mindfulness</i> praksa pomoći u rješavanju svakodnevnih problema.	1	2	3	4	5
Motiviran/a sam sudjelovati u <i>mindfulness</i> treningu.	1	2	3	4	5
I prije sam se susreo/la sa <i>mindfulness</i> praksom. Primjerice čitao/la sam o <i>mindfulness</i> -u ili tehnikama disanja, opuštanja ili suočavanja sa stresom.	1	2	3	4	5

OKRENI STRANICU!

Supplementary Material 2.

Program evaluation questionnaire administered at post-intervention (Study 2)

ISKUSTVO SUDJELOVANJA U MINDFULNESS TRENINGU

Nakon što si posljednjih tjedana sudjelovao/la u *mindfulness* treningu, molimo te da odgovoriš na nekoliko pitanja o iskustvu sudjelovanja.

Molimo te za svako pitanje označi koliko se slažeš sa tvrdnjom, pritom se vodeći slijedećom skalom: 1 = uopće se ne slažem; 3 = niti se slažem, niti se ne slažem; 5 = potpuno se slažem

	(1)	(2)	(3)	(4)	(5)
	Uopće se ne slažem	Uglavnom se ne slažem	Niti se slažem, niti se ne slažem	Uglavnom se slažem	Potpuno se slažem
Nakon sudjelovanja u <i>mindfulness</i> radionicama, bolje razumijem kako izgleda <i>mindfulness</i> praksa.	1	2	3	4	5
<i>Mindfulness</i> trening mi olakšava suočavanje u teškim ili stresnim situacijama.	1	2	3	4	5
Vjerujem da ću općenito imati koristi od <i>mindfulness</i> treninga.	1	2	3	4	5
<i>Mindfulness</i> mi može pomoći da se umirim u situacijama koje mi uobičajeno stvaraju stres ili u kojima osjećam napetost ili tjeskobu.	1	2	3	4	5
Vjerujem da mi <i>mindfulness</i> praksa može pomoći u rješavanju svakodnevnih problema.	1	2	3	4	5
I prije sam se susreo/la sa <i>mindfulness</i> praksom. Čitao/la sam o <i>mindfulness</i> -u ili tehnikama disanja, opuštanja ili suočavanja sa stresom.	1	2	3	4	5
Lako sam i bez velikih teškoća sudjelovao/la u vođenom <i>mindfulness</i> treningu.	1	2	3	4	5
Osim vođene grupne prakse, prakticirao/la sam <i>mindfulness</i> u svoje slobodno vrijeme, kada je meni odgovaralo ili bilo potrebno.	1	2	3	4	5
Lako sam i bez velikih teškoća prakticirao/la <i>mindfulness</i> u svoje slobodno vrijeme.	1	2	3	4	5
Imao/la sam teškoća pratiti vođeni <i>mindfulness</i> trening ili mi nije bilo jasno što bih trebao/a činiti.	1	2	3	4	5

OKRENI STRANICU!

Jesi li primijetio/la neke promjene u svakodnevnom funkcioniranju (*npr. Manje burno reagiraš kada te netko naljuti. / Možeš se lakše i brže umiriti kada si pod stresom. / Zapažaš detalje u svojoj okolini.*) nakon sudjelovanja u vođenom *mindfulness* treningu?

Ukoliko želiš podijeliti neka druga iskustva ili razmišljanja vezano uz tvoje iskustvo sudjelovanja u *mindfulness* praksi, molimo te upiši ih ovdje.

Supplementary Material 3.

Program evaluation questionnaire administered at follow-up (Study 2)

ISKUSTVO MINDFULNESS PRAKSE

Nakon što su posljednjih tjedana prakticirao/la *mindfulness* tehnike, molimo te da odgovoriš na nekoliko pitanja o svome iskustvu s *mindfulness*-om.

Molimo te za svako pitanje označi koliko se slažeš sa tvrdnjom, pritom se vodeći slijedećom skalom: 1 = uopće se ne slažem; 3 = niti se slažem, niti se ne slažem; 5 = potpuno se slažem

	(1) Uopće se ne slažem	(2) Uglavnom se ne slažem	(3) Niti se slažem, niti se ne slažem	(4) Uglavnom se slažem	(5) Potpuno se slažem
<i>Mindfulness</i> trening mi olakšava suočavanje u teškim ili stresnim situacijama.	1	2	3	4	5
Vjerujem da općenito imam koristi od <i>mindfulness</i> prakse.	1	2	3	4	5
<i>Mindfulness</i> mi može pomoći da se umirim u situacijama koje mi uobičajeno stvaraju stres ili u kojima osjećam napetost ili tjeskobu.	1	2	3	4	5
Vjerujem da mi <i>mindfulness</i> praksa može pomoći u rješavanju svakodnevnih problema.	1	2	3	4	5
Osim vođene grupne prakse, prakticirao/la sam <i>mindfulness</i> u svoje slobodno vrijeme, kada je meni odgovaralo ili bilo potrebno.	1	2	3	4	5
Lako sam i bez velikih teškoća prakticirao/la <i>mindfulness</i> u svoje slobodno vrijeme.	1	2	3	4	5
Imao/la sam teškoća primjenjivati <i>mindfulness</i> tehnike ili mi nije bilo jasno što bih trebao/a činiti.	1	2	3	4	5
Bilo mi je korisno prakticirati <i>mindfulness</i> tehnike u svoje slobodno vrijeme.	1	2	3	4	5
Preporučio/la bih prijateljima da prakticiraju <i>mindfulness</i> tehnike.	1	2	3	4	5
Nastaviti ću primjenjivati <i>mindfulness</i> tehnike i dalje u svakodnevnom životu.	1	2	3	4	5

OKRENI STRANICU!

Koliko si posljednjih tjedana nakon završetka radionica dana prakticirao/la *mindfulness* tehnike:

1	2	3	4	5
(nikada)	(jednom mjesečno)	(jednom tjedno)	(gotovo svaki dan)	(svaki dan)

Molimo te označi one *mindfulness* vježbe koje si vježbao u slobodno vrijeme (izuzev radionica), na skali:

1 – nikada 2 – rijetko 3 – povremeno 4 – često 5 – svaki dan

- | | | | | | |
|---------------------------------|---|---|---|---|---|
| • Skeniranje tijela (Body scan) | 1 | 2 | 3 | 4 | 5 |
| • Dah kao sidro | 1 | 2 | 3 | 4 | 5 |
| • Svjesnost osjećaja | 1 | 2 | 3 | 4 | 5 |
| • Mindful pokreti | 1 | 2 | 3 | 4 | 5 |
| • <i>Loving-kindness</i> praksa | 1 | 2 | 3 | 4 | 5 |
| • Drugo _____ | 1 | 2 | 3 | 4 | 5 |

(npr. Neke od svakodnevnih *mindful* aktivnosti)

Molimo te da u nekoliko rečenica opišeš svoje iskustvo s *mindfulness* tehnikama.

Ukoliko nisi vježbao/la *mindfulness* u svoje slobodno vrijeme, molimo te navedi zašto.

Jesi li doživio/doživjela neke neugodnosti ili teškoće tijekom vježbanja *mindfulness* tehnika u svoje slobodno vrijeme?

OKRENI STRANICU!

Jesi li primijetio/la neke promjene u svakodnevnom funkcioniranju (*npr. Manje burno reagiraš kada te netko naljuti. / Možeš se lakše i brže umiriti kada si pod stresom. / Zapažaš detalje u svojoj okolini.*) nakon primjene *mindfulness* tehnika?

Ukoliko želiš podijeliti neka druga iskustva ili razmišljanja vezano uz tvoje iskustvo prakticiranja *mindfulness*-a, molimo te upiši ih ovdje.

Hvala ti na sudjelovanju u istraživanju!

13. BIOGRAPHY

Filipa Čavar Mišković, mag.psych., was born on June 15th, 1995, in Zagreb, Croatia. After completing secondary education (IV. Gymnasium Zagreb) in 2014, she enrolled in the Bachelor of Science program in Psychology at Catholic University of Croatia. In 2020, she completed her Master of Science degree in Psychology from Catholic University of Croatia, defending her thesis titled “*The Role of Mindfulness in Intimate Relationships*”. During her master’s degree, she coordinated student-led research on stress exposure, co-authored workshops on interpersonal relationships, gained teaching experience as a course tutor and completed a traineeship at the Zagreb Child and Youth Protection Centre, working with trauma-exposed children and youth. From 2020 to 2021, she worked as a school psychologist at an elementary school in Zagreb, delivering individual and group counselling, assessments, and preventive mental health workshops.

In 2021, she enrolled in the doctoral program in Prevention Science at the University of Zagreb, Faculty of Education and Rehabilitation Sciences. Since 2021, she has been employed at the Institute of Social Sciences “Ivo Pilar”, as a graduate research assistant on the scientific project funded by the Croatian Science Foundation. Her main work is focused on stress and mental health research (projects *STRESS LOAD* and *DISTRESS*). Her broader research interests encompass topics on mental health promotion and stress research.

In 2024, she completed a research visit at the University of Cambridge, Department of Psychiatry (ChARM Group). She is trained in mindfulness practices and has completed the foundational 8-week Mindfulness-Based Cognitive Therapy (MBCT) program (HUBIKOT, 2021), and the 8-week Mindfulness-Based Sustainable Transformation (MBST) program as a scholarship recipient (Mindful Society Global Institute, 2023). She maintains an active mindfulness practice with the Oxford Mindfulness Foundation and the Mindfulness & Health Institute. She was a recipient of a CAL STAR Network, UCLA traineeship for *Stress, Health, and Resilience Training Program* (2023–2024).

She has coauthored 10 scientific papers (6 as first author) and actively presented at numerous national and international scientific conferences. She is a certified psychologist and member of the Croatian Psychological Chamber, the European Network for Social and Emotional Competence (ENSEC), Stress, Trauma, Anxiety and Resilience Society (STAR) and the Centre for Reproductive Mental Health.

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