Supplementary Table 1. Search strategy.

PubMed Search – Run 9/14/2023

Search	Query	Items Found
1	"Female"[Mesh] OR "women"[Mesh] OR "female"[tw] OR "females"[tw] OR "women"[tw] OR "woman"[tw] OR "woman-identified"[tw] OR "women-identified"[tw] OR "women-identifying"[tw] OR "woman-identifying"[tw] OR "female-identifying"[tw] OR "female-identified"[tw] OR "woman identified"[tw] OR "women identified"[tw] OR "women identifying"[tw] OR "woman identifying"[tw] OR "female identifying"[tw] OR "female identified"[tw]	10,073,516
2	((student[tw] OR college[tw] OR collegiate[tw] OR OR intercollegiate[tw] OR intramural[tw] OR club[tw] OR university [tw] OR varsity [tw]) AND (athlete [tw] OR athletes [tw] OR athletics [tw] OR sport [tw] OR sports [tw])) OR ("athletes/psychology"[Mesh] OR "NCAA"[tw] OR "Athletic Coast Conference" [tw] OR "Big 10"[tw] OR "Southeastern Conference" [tw] OR "Pac 12"[tw] OR "Big 12"[tw] OR "NAIA"[tw] OR "National Collegiate Athletic Association"[tw] OR "National Association of Intercollegiate Athletics"[tw])	18,531
3	((common-mental-disorder[tw] OR common-mental-disorders[tw] OR depression[tw] OR depressive-disorder[tw] OR depressive-disorders[tw] OR mood-disorder[tw] OR mood-disorders[tw] OR anxiety[tw] OR generalized-anxiety-disorder[tw] OR acute-stress-disorder[tw] OR acute-stress-disorders[tw] OR traumatic-stress-disorder[tw] OR traumatic-stress-disorders[tw] OR post-traumatic-stress-disorder[tw] OR posttraumatic-stress-disorder[tw] OR post-traumatic-stress-disorders[tw] OR posttraumatic-stress-disorders[tw] OR PTSD[tw] OR posttraumatic-neuroses[tw] OR post-traumatic-neuroses[tw] OR post-traumatic-neuroses[tw]) AND (diagnosis[tw] OR diagnose*[tw] OR disorder[tw] OR disorders[tw] OR psychiatr*[tw] OR psychotherap*[tw] OR psycholog*[tw] OR cognitive-behavioral-therapy[tw] OR cognitive-behavioural-therapy[tw] OR clinical[tw] or clinically[tw] OR baseline[tw] OR pre-existing[tw])) OR (Depressive Disorder[Majr] OR Depressive Disorder, Major[Majr] OR Anxiety Disorders[Majr] OR Stress Disorders, Traumatic[Majr] OR Stress Disorders, Traumatic, Acute[Majr] OR Stress Disorders, Post Traumatic[Majr])	622,399
4	1 AND 2 AND 3	496

PubMed before duplicate removal: 496

PubMed after duplicate removal: 495

CINAHL Plus with Full Text Search – Run 9/14/2023

Search	Query	Items Found
1	MH (female OR women OR woman OR female) OR AB (female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”) OR TI (female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”)	2,398,022
2	(MM “Athletes, College”) OR (MM “Athletes, Female”) OR ((student OR college OR collegiate OR intercollegiate OR intramural OR club OR university OR varsity) AND (athlete OR athletes OR athletics OR sport OR sports)) OR NCAA OR "Athletic Coast Conference" OR "Big 10" OR "Southeastern Conference" OR "Pac 12" OR "Big 12" OR NAIA OR "National Collegiate Athletic Association" OR "National Association of Intercollegiate Athletics"	27,117
3	(MM “Mental Disorders/DI”) OR (MM “Stress, Psychological”) OR (MH “Mental Health”) OR (MH “Depression/DI/PF”) OR (MM "Anxiety/DI/CL/PF") OR (MM "Anxiety Disorders/DI/CL/PF") OR ((common-mental-disorder OR common-mental-disorders OR depression OR depressive-disorder OR depressive-disorders OR mood-disorder OR mood-disorders OR anxiety OR generalized-anxiety-disorder OR acute-stress-disorder OR acute-stress-disorders OR traumatic-stress-disorder OR traumatic-stress-disorders OR post-traumatic-stress-disorder OR posttraumatic-stress-disorder OR post-traumatic-stress-disorders OR posttraumatic-stress-disorders OR PTSD OR posttraumatic-neuroses OR post-traumatic-neuroses OR post-traumatic-neuroses) AND (diagnosis OR diagnose* OR disorder OR disorders OR psychiatr* OR psychotherap* OR psycholog* OR cognitive-behavioral-therapy OR cognitive-behavioural-therapy OR clinical OR clinically OR baseline OR pre-existing))	301,984
4	1 AND 2 AND 3	421

CINAHL before duplicate removal: 421

CINAHL after duplicate removal: 317

PsychINFO Search – Run 9/14/2023

Search	Query	Items Found
1	MA (female OR women OR woman OR female) OR AB (female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”) OR TI (female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”)	1,288,141
2	DE "College Athletes" OR DE "Athlete Mental Health" OR DE "Athletic Identity" OR ((student OR college OR collegiate OR intercollegiate OR intramural OR club OR university OR varsity) AND (athlete OR athletes OR athletics OR sport OR sports)) OR NCAA OR "Athletic Coast Conference" OR "Big 10" OR "Southeastern Conference" OR "Pac 12" OR "Big 12" OR NAIA OR "National Collegiate Athletic Association" OR "National Association of Intercollegiate Athletics"	66,839
3	DE "Anxiety Disorders" OR DE "Stress and Trauma Related Disorders" OR (DE "Major Depression" OR DE "Recurrent Depression" OR DE "Depression (Emotion)") OR TI ((common-mental-disorder OR common-mental-disorders OR depression OR depressive-disorder OR depressive-disorders OR mood-disorder OR mood-disorders OR anxiety OR generalized-anxiety-disorder OR acute-stress-disorder OR acute-stress-disorders OR traumatic-stress-disorder OR traumatic-stress-disorders OR post-traumatic-stress-disorder OR posttraumatic-stress-disorder OR post-traumatic-stress-disorders OR posttraumatic-stress-disorders OR PTSD OR posttraumatic-neuroses OR post-traumatic-neuroses OR post-traumatic-neuroses) AND (diagnosis OR diagnose* OR disorder OR disorders OR psychiatr* OR psychotherap* OR psycholog* OR cognitive-behavioral-therapy OR cognitive-behavioural-therapy OR clinical OR clinically OR baseline OR pre-existing)) OR AB ((common-mental-disorder OR common-mental-disorders OR depression OR depressive-disorder OR depressive-disorders OR mood-disorder OR mood-disorders OR anxiety OR generalized-anxiety-disorder OR acute-stress-disorder OR acute-stress-disorders OR traumatic-stress-disorder OR traumatic-stress-disorders OR post-traumatic-stress-disorder OR posttraumatic-stress-disorder OR post-traumatic-stress-disorders OR posttraumatic-stress-disorders OR PTSD OR posttraumatic-neuroses OR post-traumatic-neuroses OR post-traumatic-neuroses) AND (diagnosis OR diagnose* OR disorder OR disorders OR psychiatr* OR psychotherap* OR psycholog* OR cognitive-behavioral-therapy OR cognitive-behavioural-therapy OR clinical OR clinically OR baseline OR pre-existing))	389,837
4	1 AND 2 AND 3	1,167

PsychINFO before duplicate removal: 1167

PsychINFO after duplicate removal: 1047

SportDiscus Search – Run 9/14/2023

Search	Query	Items Found
1	SU (female OR women OR woman OR female) OR AB (female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”) OR TI (female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”)	229,694
2	DE "COLLEGE athletes" OR DE "WOMEN college athletes" OR DE "MENTAL health of athletes" OR (AB (student OR college OR collegiate OR intercollegiate OR intramural OR club OR university OR varsity) AND AB (athlete OR athletes OR athletics OR sport OR sports)) OR (TI (student OR college OR intercollegiate OR intramural OR club OR university OR varsity) AND TI (athlete OR athletes OR athletics OR sport OR sports)) OR NCAA OR "Athletic Coast Conference" OR "Big 10" OR "Southeastern Conference" OR "Pac 12" OR "Big 12" OR NAIA OR "National Collegiate Athletic Association" OR "National Association of Intercollegiate Athletics"	120,046
3	DE "PSYCHOLOGICAL stress" OR DE "MENTAL health of athletes" OR DE "MENTAL depression" OR DE "DEPRESSION in college students" OR DE "ANXIETY" OR ((common-mental-disorder OR common-mental-disorders OR depression OR depressive-disorder OR depressive-disorders OR mood-disorder OR mood-disorders OR anxiety OR generalized-anxiety-disorder OR acute-stress-disorder OR acute-stress-disorders OR traumatic-stress-disorder OR traumatic-stress-disorders OR post-traumatic-stress-disorder OR posttraumatic-stress-disorder OR post-traumatic-stress-disorders OR posttraumatic-stress-disorders OR PTSD OR posttraumatic-neuroses OR post-traumatic-neuroses OR post-traumatic-neuroses) AND (diagnosis OR diagnose* OR disorder OR disorders OR psychiatr* OR psychotherap* OR psycholog* OR cognitive-behavioral-therapy OR cognitive-behavioural-therapy OR clinical OR clinically OR baseline OR pre-existing))	34,366
4	1 AND 2 AND 3	424

SportDiscus before duplicate removal: 424

SportDiscus after duplicate removal: 285

Web of Science Search – Run 9/14/2023

Search	Query	Items Found
1	TS=((female OR females OR women OR woman OR woman-identified OR women-identified OR women-identifying OR woman-identifying OR female-identifying OR female-identified OR “woman identified” OR “women identified” OR “women identifying” OR “woman identifying” OR “female identifying” OR “female identified”))	2,882,234
2	TS=(((student OR college OR collegiate OR intercollegiate OR intramural OR club OR university OR varsity) AND (athlete OR athletes OR athletics OR sport OR sports)) OR NCAA OR "Athletic Coast Conference" OR "Big 10" OR "Southeastern Conference" OR "Pac 12" OR "Big 12" OR nail OR "National Collegiate Athletic Association" OR "National Association of Intercollegiate Athletics")	84,595
3	TS=(((common-mental-disorder OR common-mental-disorders OR depression OR depressive-disorder OR depressive-disorders OR mood-disorder OR mood-disorders OR anxiety OR generalized-anxiety-disorder OR acute-stress-disorder OR acute-stress-disorders OR traumatic-stress-disorder OR traumatic-stress-disorders OR post-traumatic-stress-disorder OR posttraumatic-stress-disorder OR post-traumatic-stress-disorders OR posttraumatic-stress-disorders OR PTSD OR posttraumatic-neuroses OR post-traumatic-neuroses OR post-traumatic-neuroses) AND (diagnosis OR diagnose* OR disorder OR disorders OR psychiatr* OR psychotherap* OR psycholog* OR cognitive-behavioral-therapy OR cognitive-behavioural-therapy OR clinical OR clinically OR baseline OR pre-existing)))	554,542
4	#1 AND #2 AND #3	426

Web of Science before duplicate removal: 426

Web of Science after duplicate removal: 232

Google Scholar (first 100 results) – keywords: anxiety, depression, stress, student, athletes, women/female

- All articles of interest were in the identified articles already selected for screening.

Methods Section

Search Methods

A systematic search strategy was established between the lead researcher [author LB] and a team of experienced academic librarians specializing in health science systematic reviews and meta-analyses. The search strategies were created using a combination of subject headings and keywords and were used to search PubMed via the National Library of Medicine (NLM), CINAHL via EBSCO, and APA PsycInfo via EBSCO, SportDiscus via EBSCO, and Web of Science via Clarivate on June 29, 2022. The search was re-run on September 14, 2023, for all five databases. Databases were searched from 1972 [enactment of Title IX] through September 14, 2023, to identify eligible citations. Hand searching of citations (i.e., bibliography search) from included studies from the database searches was completed from study inception through September 20, 2023.

Search Results

The searches for original research studies in PubMed, CINAHL, PsycInfo, SportDiscus, and Web of Science on June 29th, 2022, yielded a total of 2,609 citations. Citations were imported to Covidence, an online software program for managing systematic reviews. Duplicates were removed through Covidence automation leaving a total of 2,099 unique citations. The first five pages (100 citations) on Google Scholar were searched using keywords [anxiety, depression, stress, student, athletes, women/female] and 32 citations were identified. The Google Scholar citations were cross-referenced with the database citations, all Google Scholar citations identified for possible inclusion were duplicates with citations already included for review; thus, the records were removed before screening. The search re-run of all five databases on September 14, 2023, generated 298 new citations, which led to a total of 2,397 unique citations. The first five pages (100 citations) on Google Scholar were re-searched using keywords [anxiety, depression, stress, student, athletes, women/female] on September 16, 2023, and no unique citations were identified. Searches were re-run on December 23rd, 2023, to identify any studies prior to 1973, 2 studies were identified from SportDiscus and included for screening. Forty-five studies were selected via this process for the systematic review. The citation list of the selected articles was hand searched from study inception through September 20th, 2023, which yielded 72 articles for review. Ultimately, seven additional studies were included for analysis totalling 52 selected studies for the systematic review.

All authors from the original database search were contacted by the lead author LB for data for the meta-analysis in early March 2023 and provided six weeks for return of data by mid-April 2023. Authors were emailed twice requesting correlations coefficients specific to their study determinant(s) and depression, anxiety, and/or stress as well as offered to share their de-identified data for our team to analyze. Authors from the hand searches were contacted by LB for data for the meta-analysis within one week of the articles being identified and given until June 7th, 2023, to provide data. Authors from the re-run database search were contacted by the lead author LB for data for the meta-analysis and asked to provide data if feasible by September 28th, 2023. Given the brevity in turnaround time, only one author from the five papers added in the updated search was able to provide data which was then included in the meta-analysis. Additionally, one paper also included the necessary correlation coefficients thus was also included in the meta-analysis.

In summary, 12 of the 50 contacted authors (24%) shared their data and/or correlation coefficients; however, one study was not able to be included in the meta-analysis because the determinant was unquantifiable. Two additional studies were included in the meta-analysis because the papers published the necessary data for a meta-analysis. Accordingly, 13 articles were included in the meta-analysis.

Supplementary Table 2. Summary of included studies.

Study	Title	Year	Study Design	Purpose	NCAA Division (I, II, III)	Mean Age (SD) years	Freshman (%)	*N* (female only)	Female (%)	White (%)	Sports (#)
Anderson et al.	Self-reported mental health measures among incoming collegiate student-athletes who had SARS-COVID-19	2023	Longitudinal/Cohort Study	Compare patient-reported mental health outcomes for incoming collegiate athletes who did (COVID+) and did not (COVID-) have COVID-19.	DI	18.9 (0.16)	-	94	41.6	81.6	15
Appaneal et al.	Measuring postinjury depression among male and female competitive athletes	2009	Quasi-experimental	Examine athletes' postinjury depression symptoms using two different measurement strategies while addressing some of the design and sample limitations in previous literature	DI-DII	19.7 (2)	-	56	34.1	72	8
Armstrong & Oomen-Early	Social connectedness, self-esteem, and depression symptomatology among collegiate athletes versus nonathletes	2009	Cross-sectional	Compare collegiate athletes and nonathletes to see whether there were significant differences in the perceived levels of social connectedness, self-esteem, and depression and if an interaction among the variables of athlete status, gender, GPA, BMI, and levels of weekly exercise and sleep were associated with depression symptomatology	DI	19.8 (1.3)	29.1	136	59.9	75.8	-
Benjamin et al.	Sleep dysfunction and mood in collegiate soccer athletes	2020	Prospective Cohort Study	Examine how psychological measures, player status, and sex-related factors were associated with perceived sleep quality	DI	20 (1)	-	120	52.2	-	6

Bravata et al.	Correlations among symptoms of depression and problematic eating patterns in intercollegiate athletes	2002	Cross-sectional	Examine the relationship between eating disorders and de- pressive symptomatology in a convenience sample of intercollegiate athletes	DI	20 (1.6)	23	39	68.4	74	-
Brenner et al.	Factors associated with anxiety among Division III student-athletes during the COVID-19 pandemic: A cross-sectional study	2023	Cross-sectional	Analyze if female Division III collegiate student-athletes reported higher levels of anxiety compared to male Division III collegiate student-athletes and to determine if individual sport student-athletes will report higher levels of anxiety than team sport student-athletes.	DIII	-	-	348	59.9	82.5	-
Brown et al.	NCAA student-athlete mental health and wellness: A biopsychosocial examination	2021	Cross-sectional	Use the biopsychosocial model to explore biological and psychosocial grouping factors (i.e., sex, race, NCAA division) that may influence student-athlete mental health (e.g., anxiety, depression, stress) and overall wellness (i.e., overall health and quality of life)	DI-DIII	20.3	24.4	185	38.9	71.9	9
Bullard, J.B.	The impact of COVID-19 on the well-being of Division III student-athletes	2020	Cross-sectional	Examine the mental distress and programming needs of Division III student-athletes in response to COVID-19	DIII	-	28.7	374	53	76	21
Chandler et al.	The impacts of COVID-19 on collegiate student-athlete training, health, and well-being	2021	Cross-sectional	Determine the impact of COVID-19 and stay-at-home (SAH) orders on collegiate student-athletes' training, nutrition, sleep habits, and mental health and to identify disparities between sexes and competitive divisions	DI-DIII	20 (2)	7.6	260	64.8	87	14

Christensen et al.	Diet quality and mental health status among Division I female collegiate athletes during the covid-19 pandemic	2021	Cross-sectional	Examine the association between diet quality and mental health among Division 1 Female Collegiate Athletes during the COVID-19 Pandemic	DI	19.3 (1.5)	32.9	77	100	68.35	6
Covassin et al.	Postinjury anxiety and social support among collegiate athletes: A comparison between orthopaedic injuries and concussions	2014	Cross-sectional	Compare the anxiety and social support of athletes with concussions and a matched group of athletes with orthopaedic injuries	DI	22.7 (1.7)	22.2	34	27	-	9
Covassin et al.	Exploring the relationship between depression and seasonal affective disorder in incoming first year collegiate student-athletes	2019	Cross-sectional	Examine the prevalence, sex differences, and relationship between symptoms of depression and seasonal affective disorder (SAD) in collegiate student-athletes	DI	-	100	171	57.8	-	16
Cox et al.	Investigating the prevalence and risk factors of depression symptoms among NCAA Division I collegiate athletes	2017	Cross-sectional	Determine an overall prevalence rate for depression symptoms among National Collegiate Athletic Association (NCAA) Division I collegiate athletes while also assessing various risk factors that may increase an athlete's vulnerability to depression	DI	-	30.5	622	65.5	83.9	-
de Souza et al.	Patterns of health behaviors affecting mental health in collegiate athletes	2019	Cross-sectional	Examine the association of multiple health behaviors to mental health functioning in male and female collegiate athletes	DI	18.5 (1)	100	83	45.4	-	16

Evers et al.	The adaptation and evaluation of a pilot mindfulness intervention promoting mental health in student athletes	2021	Pilot Study/Quasi-experimental	Examine the effectiveness of a pilot mindfulness program for student athletes by assessing mental health, mindfulness ability, and perceived stress before and after the intervention	DIII	20 (1)	6.89	22	75.9	93.1	14
Fogaca, J. L.	Combining mental health and performance interventions: Coping and social support for student-athletes	2018	Quasi-experimental	Teach college student-athletes coping skills to improve both performance and mental health and increase their social support from coaches and captains	DI	19.8 (1.1)	38.6	45	51	83	-
Garver et al.	Change-event steals "athlete" from "college athlete": Perceived impact and depression, anxiety, and stress	2021	Cross-sectional	Assess the perceived impact and impact on mental health (e.g., depression, anxiety, and stress) of the change-event of COVID- 19 on college athletes and members of other campus groups	DII	20 (1.6)	-	124	49.8	-	12
Graupensperger et al.	Social (un)distancing: teammate interactions, athletic identity, and mental health of student-athletes during the COVID-19 pandemic	2020	Prospective Cohort Study	Examined how student-athletes' mental health was associated with teammate social support, connectedness, and changes to athletic identity from before to during COVID-19	DII; DIII	19.8 (1.4)	-	135	62.9	-	-
Gross et al.	An empirical examination comparing the Mindfulness-Acceptance-Commitment approach and psychological skills training for the mental health and sport performance of female student athletes	2003	Randomized Control Trial	Investigate the effectiveness of the Mindfulness-Acceptance-Commitment (MAC) approach compared to traditional Psychological Skills Training (PST) for the mental health and sport performance of female collegiate athletes	DIII	-	45.5	18	100	18.2	-

Guo et al.	Differences in postinjury psychological symptoms between collegiate athletes with concussions and orthopedic injuries	2018	Prospective Cohort Study	Describe the differences in postinjury psychological symptoms among Division I collegiate student athletes sustained concussions versus orthopedic injures and to examine the effects of injury type on postinjury psychological symptoms during the course of recovery	DI	-	20.6	197 (# of injuries)	33% of injuries	74.5% of injuries	9
Hagiwara et al.	Relationships among sports helplessness, depression, and social support in American college student-athletes	2017	Cross-sectional	Examine the relationships between social support and mental health problems among male and female intercollegiate student-athletes	DI; DIII	20.2 (1.2)	-	99	48.5	-	15
Kontos et al.	Depression and neurocognitive performance after concussion among male and female high school and collegiate athletes	2012	Longitudinal/Cohort Study	Examine the relationship of sport-related concussion with depression and neurocognitive performance and symptoms among male and female high school and college athletes	DI	-	-	24	32	-	-
Lamb et al.	Elevated salivary IgA, decreased anxiety, and an altered oral microbiota are associated with active participation on an undergraduate athletic team	2017	Pilot Study/Cross-sectional	Compare measures of fitness, anxiety, salivary IgA, salivary cortisol, and culturable oral bacteria among female NCAA Division III athletes “in-season” (ice hockey) or “off-season” (soccer)	DIII	-	-	19	100	-	2
Leone et al.	Celiac disease symptoms in athletes: Prevalence indicators of perceived quality of life	2020	Cross-sectional	Understand Celiac disease (CD) prevalence and comorbidities are unknown in collegiate athletics	DI-DIII	20.6 (1.7)	-	57	40.4	70	-

Mikesell et al.	The relationship of resilience, self-compassion, and social support to psychological distress in women collegiate athletes during COVID-19	2023	Cross-sectional	Examine the direct and indirect relationships of resilience, self-compassion, and social support to women collegiate athletes' psychological distress.	DI-DIII	20.0 (1.3)	-	3,924	100	81.2	24
Miller et al.	Alcohol misuse among college athletes: self-medication for psychiatric symptoms?	2002	Prospective Cohort Study	Examine alcohol abuse as well as self-reported depression, anxiety, and other psychiatric symptoms among college athletes	DI	-	-	97	37	80	-
O'Connor et al.	Mood state and salivary cortisol levels following overtraining in female swimmers	1989	Cohort study	Monitor selected mood states and salivary cortisol during overtraining in a group of female college swimmers	DI	-	-	22	100	-	1
Pierce, E. F., Jr.	Relationship between training volume and mood states in competitive swimmers during a 24-week season	2002	Prospective Cohort Study	Examine the relationship between training volume and specific mood states among collegiate swimmers over the course of a competitive season	DI	19.8 (2.1)		17	58.6	-	1
Powers et al.	Predicting student-athlete mental health: Coach-Athlete relationship	2020	Cross-sectional	Investigate if coach–athlete relationships could predict college student athletes' mental health outcomes (i.e., well-being, depression, and anxiety) beyond the known effects of gender and personality on mental health	DI	19.5 (1.3)	-	56	70.9	97.5	16
Raglin et al.	State anxiety and blood pressure following 30 min of leg ergometry or weight training	1993	Prospective Cohort Study	Examine the effect of different modes of acute exercise (30 minutes of weight training or leg ergometry) on state anxiety and blood pressure	DI	20.4 (1.1)	-	11	42.3	-	-

Roby et al.	Psychological distress differs between female and male college athletes during baseline concussion assessment	2021	Cross-sectional	Examine how preseason psychological distress measures (i.e., depression, anxiety, and somatization) in college athletes are affected by sex and concussion history	DI	20.6 (1.4)	-	152	36.7	-	-
Roiger et al.	A longitudinal pilot study of depressive symptoms in concussed and injured/nonconcussed National Collegiate Athletic Association Division I student-athletes	2015	Descriptive Epidemiologic Study	Examine the extent to which National Collegiate Athletic Association Division 1 student-athletes demonstrated postinjury depressive symptoms	DI	19.8 (1.4)	-	-	-	-	6
Sanborn et al.	Prevalence of COVID-19 anxiety in Division I student-athletes	2021	Cross-sectional	Examine the prevalence of COVID-19 anxiety in 437 National Collegiate Athletic Association Division I student-athletes and its association with psychological symptoms	DI	19.7 (1.3)	-	224	51.3	-	-
Slavin et al.	Collegiate student-athlete psychological distress and counseling utilization during COVID-19	2023	Cross-sectional	Determine how gender and race related to rates of depression, stress, and counseling use at the beginning of the pandemic (April/May 2020).	DI-DIII	20.1 (1.4)	-	3,838	66.7	72.2	-
Storch et al.	Self-reported psychopathology in athletes: A comparison of intercollegiate student-athletes and non-athletes	2005	Cross-sectional	Investigate rates of psychosocial maladjustment in a sample of intercollegiate athletes and non-athletes	DI	20.9 (3)	-	51	48.6	69.8	7
Storch et al.	Strength of religious faith and psychological adjustment in intercollegiate athletes	2004	Cross-sectional	Investigate associations among religious faith and depressive symptoms, trait anxiety, and loneliness	DI	20 (1.6)	21	39	63.9	75	-

Storch et al.	Religiosity and depression in intercollegiate athletes	2002	Cross-sectional	Investigate the relationship between organizational, non-organizational, and intrinsic religiosity, and depression in intercollegiate athletes	DI	19 (.75)		51	48.6	61.9	7
Sullivan et al.	Social support and post-injury depressive and anxiety symptoms among college-student athletes	2022	Cross-sectional	Examine the effects of changes in social support on post-injury depressive and anxiety symptoms among college-student athletes	DI	-	47.1	197 injuries….not reported	33% of injuries	74.5% of injuries	9
Sullivan et al.	Relationship between social support and depressive symptoms in collegiate student athletes	2020	Prospective Cohort Study	Examine depressive symptoms in collegiate athletes and how they relate to different types and sources of social support	DI	19.7 (1.3)	60.5% (freshman & sophomores)	112	47.1	76.9	15
Tobar, David A.	Trait anxiety and mood state responses to overtraining in men and women college swimmers	2012	Prospective Cohort Study	Examine the role of trait anxiety and gender on mood state responses of college swimmers during overtraining and taper	DI	-	-	46	39.7	-	1
Tomlinson et al.	Depression in collegiate runners and soccer players: Relationships with serum 25-hydroxyvitamin d, ferritin, and fractures	2021	Prospective Observational Study	Evaluate relationships between depression versus serum 25-hydroxyvitamin D (vitamin D), serum ferritin (ferritin), and fractures across a competitive season	DI	19.8 (1.4)	-	29	56.8	-	2
Tran, AGTT	In or out of the game? Counter-stereotype paradoxes and Asian-identified student-athlete mental health	2021	Cohort study	Examine stressors (i.e., discrimination and stereotypes) and buffers (i.e., exercise) relevant to Asian-identified student-athletes' mental health.	DI-DIII	-	-	345	53.8	0	-

Turner et al.	Comparison of psychological response between concussion and musculoskeletal injury in collegiate athletes	2017	Prospective Cohort Study	Compare the psychological responses of student-athletes who have been diagnosed with a concussion to those of athletes diagnosed with musculoskeletal injuries with similar recovery duration	DI	-	33.3	13	43.3	-	-
Valster et al.	Mental health prevalence in NCAA Division III collegiate athletes	2022	Nonexperimental Trend Study/Cohort Study	Identify the level of clinically relevant self-reported mental health symptoms in National Collegiate Athletic Association (NCAA) Division III athletes and variations based on sport participation (i.e., men's or women's athletics; team or individual sports) over a two-year period	DIII	-	37.9	373	34.9	-	-
Vargas et al.	Predictors and prevalence of postconcussion depression symptoms in collegiate athletes	2015	Case-control	Describe the prevalence of depressive symptoms in a collegiate athlete sample at baseline and postconcussion, compare these levels of symptoms and change in symptoms with those of a control group with no reported concussions in the past year, and examine the baseline predictors for post-conconussion depression symptoms	DI	18.4 (.8)	-	40	31.7	68.3	6
Weber et al.	Health-related quality of life following concussion in collegiate student-athletes with and without concussion history	2018	Prospective Cohort Study	Compare global and specific health-related quality of life (HRQOL) throughout concussion recovery between those with and without concussion history	DI-DIII	19.4 (1.4)	-	112	45.9	80	19

Weber et al.	An examination of depression, anxiety, and self-esteem in collegiate student-athletes	2023	Cross-sectional	Examine the prevalence of depression, anxiety, and self-esteem in collegiate student-athletes and differences between sex, academic status, and sport type to identify associations for risks.	DI; DII	19.5 (0.1)	17.1	382	62.1	51.7	-
Wilson & Pritchard	Comparing sources of stress in college student athletes and non-athletes	2005	Cross-sectional	Compare sources of stress in first semester college freshman student athletes versus student non-athletes	DI	18.5 (1.2)	100	235	64.9	-	-
Wilson et al.	Associations among omega-3 fatty acid status, anxiety, and mental toughness in female collegiate athletes	2017	Cross-sectional	Describe omega-3 fatty acid levels in athletes and their associations with anxiety and mental toughness	DI	19.5 (1.3)	-	54	100	-	4
Wolanin et al.	Prevalence of clinically elevated depressive symptoms in college athletes and differences by gender and sport	2016	Prospective Cohort Study	Describe the prevalence of depression symptoms among NCAA division I student athletes at a single institution over 3 consecutive years	DI	-	34.2	263	56.9	88.8	12
Yang et al.	Prevalence of and risk factors associated with symptoms of depression in competitive collegiate student athletes	2007	Cohort study	Describe the prevalence of symptoms of depression among competitive collegiate student athletes and examine the factors associated with symptoms of depression among this population	DI	20 (1.3)	23.7	90	35	89.9	13
Yang et al.	Social support from the athletic trainer and symptoms of depression and anxiety at return to play	2014	Prospective Cohort Study	Examine the effect of social support received from athletic trainers during injury recovery on reported symptoms of depression and anxiety at return to play among a cohort of collegiate athletes	DI	-	20.7	131	33.8	74.9	9

Supplementary Table 3. Summary of findings.

Study	Measures	Determinant(s)	Determinant Themes	Depression, Anxiety, and/or Stress	Main Depression, Anxiety, and Stress Findings
Anderson et al.	Hospital Anxiety and Depression Scale; State-Trait Anxiety Inventory	Biological Sex; COVID-19	Biological Sex; COVID-19	Depression and anxiety	Female student-athletes reported significantly worse anxiety than males regardless of COVID-19 history. Observed differences in HADS and trait anxiety between males and females such that female student-athletes had significantly higher (worse) levels. Post-hoc testing revealed that COVID+ females had significantly worse HADS anxiety (p=.011) and STAI trait anxiety (p=.002) than all other groups.
Appaneal et al.	Center for Epidemiological Studies Depression Scale (CES-D); Hamilton Rating Scale for Depression (interview guide - more qualitative…)	Injury	Injury	Depression	The repeated measures analysis on CES-D scores showed a significant main effect for time, $F(2, 160) = 19.21$, $p < .001$, and a significant injury group by time interaction, $F(2, 160) = 5.48$, $p < .01$. There was no significant main effect of injury group or main effect for gender. As can be seen in this table, mean CES-D scores declined across time in both groups (main effect of time), but they declined much more steeply for the athletes with injury than for those without injury. Our data provided support for the expected chronological pattern of postinjury depression, wherein both athlete- and clinician-rated depression symptoms decreased over time.
Armstrong & Oomen-Early	Center for Epidemiological Studies Depression Scale (CES-D)	Social Connectedness; Biological Sex; Sleep; Self-esteem	Health; Support; Biological Sex; Self-Esteem	Depression	Collegiate athletes ($M = 13.78$, $SD = 9.09$) had lower depression than did nonathletes ($M = 16.72$, $SD = 9.81$), $F(3, 223) = 4.76$, $p < .05$. A stepwise multiple regression determined predictors of depression in college students. Overall, social connectedness, gender, sleep, and self-esteem were significant in predicting depression, $F(3, 223) = 45.25$, $p < .001$, and accounted for 45% of the variance. The following results consider when controlling for the other variables: First, an increase in social connectedness predicted a decrease in depression ($\beta = .539$, $p < .001$). Second, being a female, compared with being a male college student, predicted an increase in depression ($\beta = .163$, $p = .001$). Third, an increase in days per week of rested sleep predicted a decrease in depression ($\beta = –.154$, $p < .01$). Last, an increase in self-esteem predicted a decrease in depression ($\beta = –.124$, $p < .05$; see Table 4).
Benjamin et al.	Profile of Mood States	Sleep	Health; Biological Sex	Depression	Increased sleep dysfunction was significantly related to increased depression. The odds of reporting global sleep dysfunction were 55% lower for males than females (OR, 0.45; 95% CI, 0.25-0.79; P = 0.006). Female athletes with poor sleep quality reported significantly higher levels of depression than female athletes with good sleep quality (MD ± SE depression, 3.37 ± 0.73). There were no differences in any POMS measures between male and female participants with good sleep quality (MD ± SE depression, –0.18 ± 0.69 [P > 0.99]).
Bravata et al.	Beck Depression Inventory-II	Eating Behaviors	Health; Biological Sex	Depression	Pearson product-moment correlations indicated problematic eating patterns and depressive symptoms were not meaningfully correlated for the whole sample of intercollegiate athletes (r = -25). However, when stratified by sex, correlations were meaningful and of medium effect size for both women

					(r=32) and men (r=-39). However, sex appeared to moderate the present values such that problematic eating patterns and depressive symptoms were positively related for women, whereas these variables were negatively related for men.
Brenner et al.	Generalized Anxiety Disorder Scale (GAD-7)	Biological Sex; Sport	Biological Sex; Sport	Anxiety	Female student-athletes had an increase in mild, moderate, and severe cases of anxiety in comparison to make student-athletes. Female student-athletes reported almost three times more likely than males to report some level of anxiety (OR=2.942, CI 95% 1.958-4.421, p=.000). Significant differences were reported among female participants rostered on an individual sport team in comparison to female participants rostered on a team with teammates (p=.000). Female student-athletes rostered in an individual sport were three times more likely (PR=3.2, 95% CI, 1.66-6.16) than female athletes rostered in a team sport to report experiencing mild to severe anxiety. Female student-athletes who participated in team sports were almost two-and-half times more likely than men to report mild to severe anxiety (PR=2.45, CI 1.48-4.07). The odd's ratio among female and male rostered on a team with teammates within GAD-7 Scale responses reported that female team sport athletes had 2.449 times more chance (p=.000) of reporting anxiety than male individual sport athletes.
Brown et al.	Patient Health Questionnaire (PHQ-9); Generalized Anxiety Disorder Scale (GAD-7); Perceived Stress Scale (PSS-10)	Biological Sex; Division; Race	Biological Sex; Division; Race	Depression, anxiety, and stress	Female student-athletes reported a greater number of mental health diagnoses (M = 0.50, SD = 0.93) than male student-athletes (M = 0.32, SD = 0.69), t(471) = −2.46, p = 0.014, d = 0.23). Similarly, compared to their male counterparts, female student-athletes endorsed greater symptoms of anxiety (p < 0.001, d = 0.40), depression (p < 0.001, d = 0.34), and stress (p = 0.003, d = 0.30). Results from an independent samples t-test (White vs. student-athletes of Color) indicated that student-athletes of Color endorsed higher stress (p = 0.007, d = 0.31) than White student-athletes. However, there were no differences in mental health diagnoses (p = 0.689), anxiety (p = 0.253), or depression (p = 0.331) between the two racial groups. The effect of NCAA division was significant for anxiety, F(2, 441) = 4.32, p = 0.014, and depression, F(2, 428) = 3.72, p = 0.025. Post hoc comparisons using the Games-Howell test (due to unequal groups) revealed that anxiety (M = 6.15, SD = 5.30, p = 0.006) and depression (M = 5.34, SD = 5.12, p = 0.008) scores of DI athletes were significantly greater than anxiety (M = 4.36, SD = 4.33) and depression (M = 3.65, SD = 4.17) scores of DIII student-athletes. However, anxiety (M = 4.98, SD = 4.58) and depression (M = 4.97, SD = 4.18) scores reported by DII student-athletes did not significantly differ from DI or III participants.
Bullard, J.B.	Generalized Anxiety Disorder Scale (GAD-7)	COVID-19	COVID-19	Anxiety	Significant findings revealed that female participants were more likely than male participants to express worry for the future during the COVID-19 pandemic. Mental distress was associated with lack of resources and the absence of available facilities to train for their sport. This setback led student-athletes to experience increased feelings of stress.

Chandler et al.	State-Trait Anxiety Inventory (adapted questions)	Stay At Home	Training Volume; Division	Depression, anxiety, and stress	When asked about the psychological impact of continuing to train during stay at home (SAH), 43.9% (n = 109) of females indicated their training increased their stress levels in contrast to 26.2% (n = 26) of males. In terms of division, significantly more D3 respondents reported increased feelings of stress, tension during SAH.
Christensen et al.	Depression, Anxiety, Stress Scale (DASS-21)	Diet Quality	Health	Stress	For the DASS-21, a significant difference in Health Eating Index (HEI) was found between participants who reported low and high stress (low stress = 56.1, high stress = 62.6, p = 0.015). Participants with worse mental health consistently had higher HEI scores than their counterparts. In sum, HEI scores were significantly positively associated with stress (p = 0.015)
Covassin et al.	State-Trait Anxiety Inventory	Concussions and Orthopedic Injuries	Injury	Anxiety	No differences for the State-Trait Anxiety Inventory (t = 1.38, P = .193) between the concussed and orthopedic-injury groups. Social Support Questionnaire scores were significant predictors for postinjury state anxiety. Specifically, increased scores were associated with decreased postinjury state anxiety (b = 4.21, P = .0001).
Covassin et al.	Beck Depression Inventory-II	Seasonal Affective Disorder; Academic Year	Seasonal Affective Disorder; Academic Year	Depression	Our results revealed a positive correlation between symptoms of depression and seasonal affective disorder (SAD). Specifically, freshman student-athletes who had increased SAD also had increased symptoms of depression.
Cox et al.	Center for Epidemiological Studies Depression Scale (CES-D)	Biological Sex; Academic Year; Season; Injury	Biological Sex; Academic Year; Season; Injury	Depression	A significant difference was found for sex, t (947) = -3.30, P = 0.00. Female athletes (m = 14.46, SD = 10.64) reported significantly higher rates of depression symptoms than male athletes (m = 12.10, SD = 10.10). Although originally expected to be a variable of interest for the study, race was not included as an independent variable due to unequal sample sizes. A significant difference was found for academic class, F (1, 932) = 6.67, P = 0.01, 2 = 0.01, β = 0.73. Lowerclassmen (m = 14.36, SD = 11.08) reported significantly higher rates of depression symptoms than upperclassmen (m = 12.74, SD = 9.65). A significant difference was also found for sport season status, F (1, 932) = 3.98, P = 0.05, 2 = 0.004, β = 0.51. Athletes in the off-season (m = 13.14, SD = 10.39) reported significantly lower rates of depression symptoms compared to in-season athletes (m = 14.10, SD = 10.60). Athletes who had suffered an injury in the previous 6 months (m = 14.49, SD = 10.99) reported significantly higher levels of depression symptoms than those who had remained healthy during this time (m = 13.07, SD = 10.12). A further t test was performed to determine whether, for those who had suffered an injury in the last 6 months, missing practice or competition due to this injury affected depression scale scores. A significant difference was found t (155) = 4.16, P = 0.00, suggesting that those who were forced to miss activity (m = 15.30, SD = 11.52) scored significantly higher on the CES-D than those who did not (m = 10.85, SD = 7.04). Analysis of the means suggests that athletes who are injured for less than 1 month (m = 15.84, SD = 11.96) or for longer than 6 months (m = 16.25, SD = 10.65) generally report higher depressive symptoms scores than those who

					are injured for 1-3 months (m = 13.69, SD = 10.99) or 3-6 months (m = 14.92, SD = 11.46).
de Souza et al.	Profile of Mood State; Brief Symptom Inventory-18; Perceived Stress Scale (PSS-4)	Diet; Nutrition; Alcohol; Aggression	Health	Depression, anxiety, and stress	There were no significant differences in mental health outcomes (BSI-18 and PSS total scores) between males and females (p > .05). Increased psychological distress and stress symptoms were associated with increased aggressive behaviors and alcohol use, and reduced energy across the whole sample of participants. Higher psychological distress and stress symptoms were associated with greater aggressive behaviors and more frequent alcohol use, and reduced energy for both males and females. Higher psychological distress was associated with more unhealthy dietary habits, reduced attention to nutrition, and less frequent alcohol use in female athletes. The effect was not significant for stress symptoms or in male athletes.
Evers et al.	Perceived Stress Scale (PSS-10)	Mindfulness Pilot	Intervention	Stress	When examining perceived stress, the results indicated that the mean overall perceived stress postintervention (M = 16.48, SD = 5.07) was less than the mean overall perceived stress preintervention, albeit not statistically significant (M = 18.66, SD = 4.79), t(28) = 1.86, p = .073; with d = 0.35, a small effect size is indicated.
Fogaca, J. L.	Beck Anxiety Inventory; Beck Depression Inventory	Mental Skills Training (Intervention)	Intervention	Depression and anxiety	Anxiety, F(1, 79) = 5.017, p = .028, significantly improved for the intervention group, compared to the control group. An intervention that teaches student-athletes how to use mental skills both during performance and in other life domains has the potential to improve mental health-related outcomes.
Garver et al.	Depression, Anxiety, Stress Scale – 21 (DASS-21)	Sport; Biological Sex	Sport; Biological Sex	Depression, anxiety, and stress	ANOVA results detected no effect of sport/campus group on depressive symptoms F(14,221)=1.238, p=0.249. The grand mean for all groups (10.1) was within the mild depression range. Females (11.5 ± 9.2; mild depression) had a higher mean depression subscale score (p=0.016) than males (8.7 ± 8.7; normal). On the anxiety subscale, Levene's test revealed unequal variances, and Kruskal–Wallis revealed a significant difference between sports $\chi 2(14)=25.362$, p=0.031. Differences were found between baseball and several sports or groups (cheerleading, volleyball, soccer, softball, and marching band), eSports and several sports or groups (volleyball, soccer, softball, and marching band), basketball and several sports or groups (soccer and marching band), football and marching band, and track and field and marching band. However, all differences were found to be nonsignificant after Bonferroni correction. ANOVA results detected no effect of sport/campus group on stress F(14,221)=1.550, p=0.095. The grand mean for all groups (11.8) was within the normal range. Females (13.5 ± 9.0) had significantly higher stress subscale scores (p=0.003) than did than males (10.0 ± 8.9) although, both groups were in the normal range for stress.
Graupensperger et al.	Patient-Reported Outcomes Measurement Information System	Teammate Support; Identity	Support; Identity	Depression	Student-athletes who experienced greater support reported less identity dissolution and, in turn, fewer symptoms of depression. Changes in identity were negatively associated with symptoms of depression. Thus, positive associations between teammate social interactions and identity maintenance and subsequently, that identity maintenance was negatively associated with

					symptoms of depression. Student-athletes who experienced less identity dissolution following the abrupt cancelation of college sports reported greater indices of mental health and well-being.
Gross et al.	Counselling Centre Assessment of Psychological Symptoms-62	Mindfulness-Acceptance-Commitment	Intervention	Depression and anxiety	Results revealed a statistically significant within-group main effect of time on the following subscale scores: Generalized Anxiety (F (2, 32) = 5.24, p = .01, h2p = .25), demonstrating that differences existed within one or both of the groups across time. Pairwise comparisons revealed that the MAC participants had statistically significant decreases from post-intervention to one-month follow-up on Generalized Anxiety (p = .00). A within-group main effect of time was not found for the subscales: Depression (F (2, 32) = 1.04, p = .37, h2p = .06) and Social Anxiety (F (2, 32) = 0.70, p = .50, h2p = .04).
Guo et al.	Center for Epidemiological Studies Depression Scale (CES-D); State-Trait Anxiety Inventory	Concussions & Orthopedic Injuries	Injury	Depression and anxiety	No significant differences in average depressive symptom scores were observed between the concussion (mean score = 10.77) and orthopedic injury (mean score = 10.81) groups at the baseline (P = 0.9729) and at 1-week postinjury follow-up (P = 0.1475). However, the average depressive symptom score in the concussion group was significantly higher than the orthopedic injury group at the 1- month postinjury follow-up (P = 0.0264). In addition, the 2 groups did not differ in anxiety scores at baseline (P = 0.8757) or at each postinjury follow-up (P's = . 0.05). A significant interaction between injury type and time loss was found for postinjury depressive symptoms (B = 8.49, P = 0.0259). Depressive symptom score increased in the concussion group from 1-week to 1- month postinjury follow-up but decreased in the orthopedic injury group during the same period. Anxiety scores decreased significantly over time for both injury types (B = 21.14, P = 0.0001).
Hagiwara et al.	Stress Response Scale for Athletes	Social Support (providing and receiving)	Support	Depression	Correlational analyses indicated, that for female intercollegiate student-athletes there were significant negative correlations between receiving social support and depression (r=-0.38) and between providing social support and depression (r=-0.29).
Kontos et al.	Beck Depression Inventory-II	Concussion; Time; Age; Biological Sex	Injury (time)	Depression	The results of a 4 (time) x 2 (age) x 2 (sex) repeated-measures ANCOVA (covaried for non-depression concussion symptoms) supported a significant within-subject effect for time (Wilk's = .85, F(3,69)=3.53, P=.001), with athletes exhibiting higher levels of depression symptoms from baseline at 2 days (P=.001), 7 days (P=.006), and 14 days post concussion (P=.04). There were no significant between-subject effects for age (F(1,60)=.59, P=.45) and sex (F(1,60)=3.74, P=.06) on depression.
Lamb et al.	Generalized Anxiety Disorder Scale (GAD-7)	salivary IgA/total protein	Health (pre- and post-season)	Anxiety	The proportion of subjects reporting "severe anxiety" on an anxiety scale (GAD-7) were significantly greater in the "off-season" group compared to the "in-season" group (p = 0.047, Chi-squared test). "In-season" athletes had significantly higher salivary IgA/total protein levels than "off-season" athletes (one-sided Student's t-test; p = 0.03). Anxiety levels (GAD-7) in the "in-season" group were positively correlated with growth of oral bacteria on blood agar (Spearman Rank correlation coefficient of 0.622 for "in-season", p value = 0.033 one-sided) and mitis salivarius agar (Spearman Rank

					correlation coefficient = 0.671 for "in-season, p value = 0.021 one-sided), and negatively correlated in "off-season" athletes on blood agar (− 0.689 for "off-season", p value = 0.028 one-sided), supporting the hypothesis that the microbiota are distinct in "in- season" and "off-season" athletes and may be associated with anxiety levels.
Leone et al.	Beck Depression Inventory, Perceived Stress Scale	Celiac Disease	Health	Depression and stress	Athletes were 3.85 times (95% CI, 0.42-34.89) more likely to report a celiac disease (CD) diagnosis and were 18.36 times (95% CI, 2.40-140.48) more likely to report a high degree of CD symptoms than the general population. Athletes with more symptoms had higher depression and perceived stress scores. There was a significant positive relationship between celiac symptom inventory (CSI) scores and Beck Depression Index (BDI) scores (r = 0.62; 95% CI, 0.50-0.71; P < 0.05; n = 138; r2 = 0.38). The Perceived Stress Scale (PSS-14) also was significantly positively correlated with the CSI (r = 0.53; 95% CI, 0.39-0.65; P < 0.05; n = 125; r2 = 0.28).
Mikesell et al.	Patient Health Questionnaire (PHQ-2); Perceived Stress Scale (PSS-10)	Resilience; Self-Compassion; Social Support	Support	Depression and stress	Correlations between depression and social support (family) was -.36, while correlations between depression and social support (friends) and depression was -.24. Correlations between perceived stress and social support (family) was -.27, while correlations between depression and social support (friends) and depression was -.22. This inverse relationship is consistent with past research among collegiate athletes during COVID-19.
Miller et al.	Beck Depression Inventory; Mini-International Neuropsychiatric Inventory; Symptoms Checklist 90	Alcohol Use	Health	Depression and anxiety	These results demonstrate that the alcohol abusing group (as assessed by a positive score on the AUDIT) report higher levels for depressive. In addition, this study reveals that as the severity of depressive and general symptoms increases in all subjects so does the level of alcohol misuse. The subjects with levels of depression or anxiety in the "clinical" range also reported heavy alcohol use.
O'Connor et al.	Profile of Mood States	Training Volume; Salvatory Cortisol	Training Volume; Health	Depression	One-way repeated measures ANOVAs revealed that the swimmers had significant alterations in depression during overtraining. Depression returned to baseline levels following the taper. Salivary cortisol was unrelated to depression during the baseline and taper phases, but it was significantly correlated during overtraining (r=.50; p<0.05).
Pierce, E. F., Jr.	Profile of Mood States	Training Volume	Training Volume	Depression	Correlations between training volume and depression (.27) was not significant.
Powers et al.	Center for Epidemiological Studies Depression Scale (CES-D); Beck Anxiety Inventory	Athlete-Coach relationship; Personality	Support	Depression and anxiety	In predicting depression, only the model including coach–athlete relationship as a predictor was significant, with a medium effect size, F(7,61) = 2.22, p = .045, R2 = .21. The combination of gender, personality, and coach–athlete relationship predicted 21% of the variance in depression scores. Adding coach–athlete relationship on the second step of the hierarchical regression accounted for an additional 15% of the variance in depression, ΔF(1, 60) = 11.37, p = .001, ΔR2 = .15. Regarding specific predictors, only coach–athlete relation- ship (β = -.43, p = .001) was a significant predictor of depression, where a stronger coach–athlete relationship was associated with lower depression scores. Neither model was significant in predicting anxiety. Gender and personality had a statistically nonsignificant contribution of 5%

					to the anxiety scores with a small effect size, F(6,60) = 0.54, p = .777, R2 = .05, and the model including coach–athlete relationship had a non-significant contribution of 11%, ΔF(7,59) = 1.05, p = .407, ΔR2 = .11.
Raglin et al.	State-Trait Anxiety Inventory	Exercise Type: Ergometry and Weight Training	Intervention	Anxiety	Repeated-measures ANOVA detected significant (P < 0.05) trial by condition effects for state anxiety. State anxiety increased P <0 . 0 0) immediately following weight training but returned to baseline for the remaining assessments. State anxiety decreased (P <0.05) below baseline at 60 min following ergometry. In summary, state anxiety response to acute physical activity appears to be dependent on the exercise mode with reductions in state anxiety associated with ergometry but not weight training.
Roby et al.	Brief Symptom Inventory 18	Concussion	Injury; Biological Sex	Depression and anxiety	A significant sex-by-concussion history interaction was found for the anxiety subscale (chi-square = -0.98, P < .01) such that women with a concussion history reported significantly higher anxiety scores than men. When examining the probability of a student- athlete reporting zero symptoms versus any symptoms, men were more likely to endorse zeros relative to women for BSI-18 total score (chi-square = 1.41, P < .01), de- pression (chi-square = 0.84, P < .01), anxiety (chi-square = 1.43, P < .01), and somatization (chi-square = 1.55, P < .01). Men were 2.3 times more likely to endorse zero depression symptoms, 4.2 times more likely to endorse zero anxiety symptoms, 4.7 times more likely to endorse zero somatization symptoms, and 4.1 times more likely to endorse zero as a total score on the BSI-18.
Roiger et al.	Center for Epidemiological Studies Depression Scale (CES-D)	Concussion	Injury	Depression	No differences in baseline depressive symptoms among subgroups were noted. After an increase between baseline and 1 week (4.3, 95% confidence interval [CI] = 0.41, 8.16, P = .02), depressive symptoms in the concussion group decreased between 1 week and 1 month (2.7, 95% CI = 4.96, 0.47, P = .01) and between 1 week and 3 months (4.0, 95% CI = 6.50, 1.49, P = .004). The injured/nonconcussed group showed differences between baseline and 1 week (4.6, 95% CI = 1.08, 8.17, P = .009) and between baseline and 1 month (3.2, 95% CI = 0.05, 6.30, P = .03). No significant differences were present in depressive symptoms between concussed participants and injured/nonconcussed participants at any of the postinjury time points.
Sanborn et al.	Beck Anxiety Inventory; Depression, Anxiety, Stress Scale (DASS-21)	COVID-19 Anxiety; Biological Sex	COVID-19; Biological Sex	Depression and anxiety	Female student-athletes exhibited significantly higher scores on DASS-21 subscales of stress, t(435) = −4.46, p < .01, 1.97 ± 2.96 versus 0.90 ± 1.96; anxiety, t(434) = −3.09, p < .01, 1.09 ± 2.13 versus 0.55 ± 1.44; and depression, t(435) = −2.48, p=.01, 1.16±2.55 versus 0.62±2.01, compared with male student- athletes. There was also a significant difference on the DASS-21 subscale of anxiety between those who responded after versus before fall sport postponement, t(434) = −2.55, p = .01, 0.65 ± 1.59 versus 1.10 ± 2.15, such that scores were lower among athletes who responded to the survey after the announcement. No other differences on DASS-21 subscale scores were identified in student-athletes who responded before versus after postponement or between fall versus spring athletes (all p's < .05). Given the significant differences identified between male and female

					student-athletes on DASS-21 subscales, multivariate analysis of variance including the before versus after postponement variable and sex was conducted and showed that the difference in the anxiety subscale among subgroups was no longer significant when controlling for sex ($p < .05$).
Slavin et al.	Patient Health Questionnaire (PHQ-2); Perceived Stress Scale (PSS-10)	Biological Sex	Biological Sex	Depression and stress	Female student-athletes reported higher rates of depression (1.88±1.64) and stress (19.65±6.14).
Storch et al.	Social Anxiety Scale for Adolescents; Personality Assessment Inventory (Depression Subscale)	Religious Faith	Religion	Depression and anxiety	Religious faith was not significantly correlated with depressive symptoms (r=.05), trait anxiety (r=.08), or loneliness (r= -.09).
Storch et al.	Beck Depression Inventory; State-Trait Anxiety Inventory-Trait version	Psychosocial Adjustment	Health; Support	Depression and anxiety	Inspection of the plot of means and univariate tests revealed that female athletes have higher depression scores, $F (1, 388) = 8.13$, $p = .01$, and social anxiety scores, $F (1, 388) = 4.45$, $p = .04$, compared to male athletes and male and female non-athletes. Level of support also varied as a function of gender and athletic status with female athletes and male non-athletes reporting less support than male athletes and female non-athletes, $F (1, 388) = 5.67$, $p = .02$.
Storch et al.	Social Anxiety Scale for Adolescents; Personality Assessment Inventory (Depression Subscale)	Religious Faith	Religion	Depression	Findings indicated that after controlling for gender in step one, only intrinsic religiosity was significantly associated with affective symptoms of depression, $F(2, 103) = 4.04$, $p < .01$, $r = -.20$, Standardized Beta = -.20. An increase of one standard deviation in intrinsic religiosity was associated with a 20% decreased likelihood of affective symptoms of depression. No other significant associations were found between religiosity and depressive symptoms ($p > .05$).
Sullivan et al.	Center for Epidemiological Studies Depression Scale (CES-D); State-Trait Anxiety Inventory	Social Support	Support	Depression and anxiety	The overall amount of social support increased from baseline to 1-week post-injury ($p < 0.05$) and then remained unchanged until RTP. The overall satisfaction with the support received increased from baseline to 1-week post-injury ($p < 0.05$) but decreased ($p < 0.05$) from 1-week post-injury to RTP. Increases in satisfaction with the support received were associated with decreases in post-injury depressive ($\beta = -0.404$), $p < 0.0001$) and anxiety symptoms ($\beta = -0.406$), $p < 0.0001$).
Sullivan et al.	Center for Epidemiological Studies Depression Scale (CES-D)	Social Support	Support	Depression	Results indicated weak, negative relationships (ranging between $r = -.38$ to $r = -.31$) between all types of social support and CES-D score, with athletic tangible ($r = -.38$) support having the strongest correlation compared to the other support types. Perceived tangible support from athletic sources, need for support, and perceived tangible support from personal sources were significant predictors of CES-D scores, ($F = 23.2$, $p < .001$). Athletic tangible support was the strongest predictor of CES-D score with a beta of −.30 ($p < .001$), and accounting for 15.1% of variance. Need for support was the second strongest predictor of CES-D score with a beta of .23 ($p < .001$), and

					accounting for 4.3% of variance. Personal tangible support was the third strongest predictor of CES-D score with a beta of −.22 (p <.001), and accounting for 3.5% of change.
Tobar, David A.	Profile of Mood States; State-Trait Anxiety Inventory	Training Volume	Training Volume; Anxiety groups	Depression and anxiety	For the interaction effect of trait anxiety and time (across gender), there was a significant effect for depression (p < .05, ηp2 = .03). Post hoc tests revealed significant differences between low and high trait anxiety groups at baseline for depression (p<.001, d=.83). The high trait anxiety group reported higher scores but no difference (p > .05) between anxiety groups at peak training or taper. For the low trait anxiety group, depression (p<.001) significantly increased from baseline to peak training. Depression improved (p's<.05) from peak training to taper for both anxiety groups, and the scores at taper were different in depression in the high trait anxiety group only (p < .005).
Tomlinson et al.	Center for Epidemiological Studies Depression Scale (CES-D)	Serum Vitamin D and Ferritin	Health (pre- and post-season)	Depression	A pre- to post- season increase in depression score was noted, of medium magnitude of effect (6.0 to 8.9; p = 0.009; effect size = 0.53). Two athletes (one male, one female; 3.9%) demonstrated clinically relevant (CES-D ≥16) depression pre-season (19.5 ± 4.9), which persisted into post-season (21.0 ± 7.1). These two participants had lower vitamin D levels pre-season (28.0 ± 0.2 vs. 49.4 ± 20.0 ng/mL; p = 0.13; effect size = 1.52) and post-season (27.7 ± 0.9 vs. 43.9 ± 18.2 ng/mL; p = 0.21; effect size = 1.27) (non-depressed vs. depressed athletes, respectively). Pre-season ferritin (81.8 ± 60.0 ng/mL) and post-season ferritin (75.2 ± 63.9 ng/mL) levels were within normal limits for these two athletes and neither participant sustained a fracture during the season. Seven athletes (two males, five females; 13.7%) demonstrated depression post-season, with medium magnitudes of effect for both lower pre-season serum vitamin D and ferritin. There were inverse relationships between serum vitamin D vs. CES-D scores pre-season and post-season, with small magnitudes of effect. An inverse relationship was found between post-season serum ferritin vs. post-season CES-D scores in the female cohort only, with a medium magnitude of effect. There were no other meaningful relationships noted between depression scores, serum vitamin D, and/or serum ferritin levels pre- or post-season (in males, females, or combined cohorts).
Tran, AGTT	Patient Health Questionnaire (PHQ-9); Generalized Anxiety Disorder Scale (GAD-7)	Discrimination and stereotypes	Race; Exercise-level (Being an athlete)	Depression and anxiety	Discrimination was positively linked to depression for Asian-identified nonstudent-athletes, regardless of exercise amount. Conversely and as expected, the associations were significant for Asian-identified student-athletes reporting a below-average amount of hourly exercise but nonsignificant for those reporting an above-average amount of hourly exercise. Following this pattern, discrimination was negatively correlated with positive mental health for Asian-identified student-athletes who exercised a below-average amount and Asian-identified nonstudent-athletes regardless of exercise amount, whereas the association was not significant for Asian-identified student-athletes who exercised an above-average level. Discrimination was positively correlated with anxiety regardless of exercise amount for both Asian-identified student-athletes and nonstudent-athletes.

					Tests of differences between pairs of slopes revealed that the slope of the below-average amount of exercise student-athlete group was significantly steeper than that of the above-average student-athlete group. This buffering was unique to student-athletes, as slopes did not differ for nonstudent-athletes.
Turner et al.	Profile of Mood States; State-Trait Anxiety Inventory	Concussions & Musculoskeletal Injuries	Injury	Depression and anxiety	There were no significant interactions, (F (2, 86) = .05, p = .96, η2 = . 001) or main effects for group (F (2, 86) = 6.32, p = .014, η2 = .073) or time (F (2, 86) = 4.53, p = .014, η2 = .102) for the Tension-Anxiety subscale. There was no interaction (F (2, 86) = 1.02, p = .386, η2 = .027) or main effect by group (F (2, 86) = .66, p = .420, η2 = .006) or time (F (2, 86) = 2.14, p = .099η2 = .054) for the state anxiety subscale of the STAI. No significant interactions were found for the Depression- Dejection subscale (F (2, 86) = .92, p = .402, η2 = .022). In addition, no main effects for group were found, (F (2, 86) = 4.87, p = .030, η2 = .057).
Valster et al.	Beck Anxiety Inventory; Harvard Department of Psychiatry/National Depression Screening Day Scale	Sport participation variation	Sport; Biological Sex	Depression and anxiety	A chi-square analysis showed a gender-dependent significant difference in expected and observed values in both Year 1 (χ2 = 4.990, p = .025, η2 = .097) and Year 2 (χ2 = 9.054, p = .003, η2 = .130) for the HANDS screening but not by sport (Year 1: p = .068; Year 2: p = .608). A chi-square analysis of the BAI screening showed a gender-dependent significant difference in expected and observed values in both Year 1 (χ2 = 9.422, p = .002, η2 = .134) and Year 2 (χ2 = 8.126, p = .004, η2 = .129). A non-significant difference in sport type was found for the BAI screening (Year 1: p = .827; Year 2: p = .237).
Vargas et al.	Beck Depression Inventory-Fast Screen	Concussion	Injury	Depression	Concussed athletes were more likely to show a reliable increase in depression symptoms than control participants (Chi-square = 5.2, P = .02). We also found several predictors of post-concussion depressive symptoms (PCDS) in the athletes, including baseline depression symptoms (r = 0.37, P = .001), baseline postconcussion symptoms (r = 0.25, P = .03), estimated premorbid intelligence (full-scale IQ; r = 0.29, P = .009), and age of first participation in organized sport (r = 0.34, P = .002). For the control group, predictors of depression symptoms at time 2 were number of previous head injuries (r = 0.31, P = .05) and baseline depression symptoms (r = 0.80, P = .001).
Weber et al.	Hospital Anxiety and Depression Scale	Concussion	Injury	Depression and anxiety	There was not an interaction between group and time for HADS-D (F4,497 = 0.78, p = 0.537) or HADS-A subscores (F4,497 = 0.93, p = 0.446). There was a main effect for concussion history group for HADS-D (F1,179 = 5.43, p = 0.021), but not for HADS-A (F1,179 = 1.67, p = 0.198). Student-athletes with one or more concussions had worse HADS-D subscores (mean = 2.16, 95% CI 1.73–2.58) compared to those without a concussion history (mean = 1.74, 1.08–1.87), although both means remained within the normal group range. There was a main effect for time on HADS-D (F4,497 = 30.14, p < 0.001), revealing that HADS-D subscores were significantly worse than baseline at 24–48 h (p < 0.001), but then became significantly better than baseline at the asymptomatic (p < 0.001), return-to-play (p < 0.001), and 6-

					month ($p < 0.001$) time points (Fig. 3). There was also a main effect for time on the HADS-A subscore ($F4,497 = 54.77$, $p < 0.001$) such that HADS-A subscores were significantly worse at baseline compared to the asymptomatic ($p < 0.001$), return-to-play ($p < 0.001$), and 6-month ($p < 0.001$) time points (Fig. 4) but did not differ at 24–48 h ($p = 0.084$).
Weber et al.	Center for Epidemiological Studies Depression Scale (CES-D); State-Trait Anxiety Inventory	Biological Sex; Academic Status; Sport Type	Biological Sex; Academic Year; Sport	Depression and anxiety	A Chi-squared analysis revealed no significant differences between the CES-D and sex ($X^2_{1,615} = 0.00$, $p = 0.99$, with females (13.8.%) reporting the same risk as males (8.5%), though it suggests that depression and anxiety signs and symptoms are present in the student-athlete population, with females predominantly more at risk than males. No significant differences were identified for depression risk and academic status (($X^2_{3,615} = 6.36$, $p = 0.095$), with sophomores ($n = 45/154$, 29.2%) and juniors ($n = 33/149$, 22.1%) reporting the highest depression risk. A Chi-squared analysis revealed no significant differences between the CES-D and sport type ($X^2_{4,615} = 3.427$, $p = 0.489$), with ball ($n = 48/194$, 24.7%) and power ($n = 28/117$, 23.9%) sports reporting the highest risk. A Chi-squared analysis revealed a significant difference for state anxiety and sex ($X^2_{2,615} = 10.46$, $p = 0.005$), and for trait anxiety and sex ($X^2_{2,615} = 10.32$, $p = 0.006$). There were no differences found for state and trait anxiety for academic status ($X^2_{6,615} = 3.53$, $p = 0.740$), ($X^2_{6,615} = 4.42$, $p = 0.620$) or for sport type ($X^2_{8,615} = 12.25$, $p = 0.141$), ($X^2_{6,158} = 4.27$, $p = 0.832$).
Wilson & Pritchard	Personality Assessment Inventory (Depression Subscale)	Support; Time; Sleep	Health; Support	Stress	Student athletes reported more stress than did non-athletes in a wide variety of variables; specifically those that dealt with conflicts with a boyfriend's or girlfriend's family, $t (359) = 2.53$, $p < .05$, to having a lot of responsibilities, $t (357) = 1.96$, $p < .05$, not getting enough time for sleep, $t (357) = 1.98$, $p < .05$, and having heavy demands from extracurricular activities, $t (359) = 8.81$, $p < .001$.
Wilson et al.	Beck Anxiety Inventory	Omega 3 Fatty Acids	Health	Anxiety	Blood levels of the HS-Omega-3 Index (rho = -0.32, p = 0.02), eicosapentaenoic acid (rho = -0.40, p = 0.003), and docosapentaenoic acid (rho = -0.33, p = 0.02) were negatively correlated with Beck Anxiety Inventory (BAI) scores. Likewise, dietary intakes of eicosapentaenoic acid (rho = -0.38, p = 0.007) and docosahexaenoic acid (rho = -0.35, p = 0.02) were negatively correlated with BAI scores.
Wolanin et al.	Center for Epidemiological Studies Depression Scale (CES-D)	Sport; Biological Sex	Sport; Biological Sex	Depression	The prevalence rate for a clinically relevant level of depressive symptoms, as measured on the CES-D (CES-D ≥16), was 23.7%. A moderate to severe level of depressive symptoms was reported by 6.3%. There was a significant gender difference in prevalence of depressive symptoms, $\chi2 (1)=7.459$, $p=0.006$, with female athletes exhibiting 1.844 times the risk of male athletes for endorsing clinically relevant symptoms.

Yang et al.	Center for Epidemiological Studies Depression Scale (CES-D); State-Trait Anxiety Inventory	Athletic Trainer Social Support	Support	Depression and anxiety	In 84.3% (n = 501) of injury events, injured athletes received social support from ATs during their recovery. Of these, 264 (53.1%) athletes reported being very satisfied with this social support. Whether or not athletes received social support from ATs during recovery did not affect the symptoms of depression or anxiety experienced at return to play. However, compared with athletes who were dissatisfied with the social support received from ATs, athletes who were very satisfied or satisfied with this social support were 87% (95% confidence interval = 0.06, 0.30) and 70% (95% confidence interval = 0.13, 0.70) less likely to report symptoms of depression at return to play, respectively. Similar results were observed for anxiety.
Yang et al.	Center for Epidemiological Studies Depression Scale (CES-D); State-Trait Anxiety Inventory	Biological Sex; Academic Year; Injury	Biological Sex; Academic Year; Injury	Depression	Athletes who were female, freshmen, or with self-reported pain were associated with significantly increased odds of experiencing symptoms of depression after adjusting for sports and other covariates. In particular, female athletes had 1.32 greater odds (95% CI, 1.01 to 1.73) of experiencing symptoms of depression compared to male student athletes. Freshmen had 3.27 greater odds (95% CI, 1.63 to 6.59) of experiencing symptoms of depression than their more senior counterparts.

Joanna Briggs Quality Assessment Items

Case-Control Studies

1. Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?
2. Were cases and controls matched appropriately?
3. Were the same criteria used for identification of cases and controls?
4. Was exposure measured in a standard, valid and reliable way?
5. Was exposure measured in the same way for cases and controls?
6. Were confounding factors identified?
7. Were strategies to deal with confounding factors stated?
8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?
9. Was the exposure period of interest long enough to be meaningful?
10. Was appropriate statistical analysis used?

Supplementary Table 4. Critical appraisal for case-control studies.

Study	1	2	3	4	5	6	7	8	9	10	Total
Vargas et al. 2015	X	X	X	X	X	X	X	X	X	X	10/10 (100%)
Total %	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	

Note. X – Yes; N – No; UC – Unclear; NR – Not Reported; N/A – Not Applicable

Joanna Briggs Quality Assessment Items

Cohort Studies

1. Were the two groups similar and recruited from the same population?
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?
3. Was the exposure measured in a valid and reliable way?
4. Were confounding factors identified?
5. Were strategies to deal with confounding factors stated?
6. Were the groups or participants free of the outcome at the start of the study (or moment of exposure)?
7. Were the outcomes measured in a valid and reliable way?
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?
10. Were strategies to address incomplete follow up utilised?
11. Was appropriate statistical analysis used?

Supplementary Table 5. Critical appraisal for cohort studies.

Study	1	2	3	4	5	6	7	8	9	10	11	Total
Anderson et al. 2023	X	X	X	UC	N/A	N	X	X	X	X	X	8/11 (72.3%)
Benjamin et al. 2020	X	X	X	X	X	UC	X	X	X	X	X	10/11 (90%)
Graupensperger et al. 2020	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Guo et al. 2018	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Kontos et al. 2012	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Miller et al. 2002	X	X	X	NR	NR	UC	X	X	X	X	X	8/11 (72.3%)
O'Connor et al. 1989	X	N/A	X	NR	NR	UC	X	X	X	X	X	7/11 (63.6%)
Pierce, E. F., Jr. 2002	X	X	X	NR	NR	UC	X	X	X	UC	UC	6/11 (54.5%)
Raglin et al. 1993	X	X	UC	NR	NR	UC	X	UC	X	X	X	6/11 (54.5%)
Roiger et al. 2015	X	X	X	NR	NR	X	X	X	X	X	X	9/11 (81.8%)
Sullivan et al. 2022	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Tobar, David A. 2012	X	X	X	NR	NR	UC	X	X	X	X	X	8/11 (72.3%)
Tomlinson et al. 2021	X	X	X	X	X	UC	X	X	X	X	X	10/11 (90%)
Turner et al. 2017	X	X	X	X	UC	N/A	X	X	X	X	X	9/11 (81.8%)
Valster et al. 2022	N/A	UC	X	X	X	X	X	X	X	X	X	9/11 (81.8%)
Weber et al. 2018	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Yang et al. 2007	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Yang et al. 2014	X	X	X	X	X	X	X	X	X	X	X	11/11 (100%)
Total %	17/18 (94%)	16/18 (89%)	17/18 (94%)	11/18 (61%)	10/18 (55%)	9/18 (50%)	18/18 (100%)	17/18 (94%)	18/18 (100%)	17/18 (94%)	17/18 (94%)	84.3%

Note. X – Yes; N – No; UC – Unclear; NR – Not Reported; N/A – Not Applicable

Joanna Briggs Quality Assessment Items

Analytical cross-sectional studies

1. Were the criteria for inclusion in the sample clearly defined?
2. Were the study subjects and the setting described in detail?
3. Was the exposure measured in a valid and reliable way?
4. Were objective, standard criteria used for measurement of the condition?
5. Were confounding factors identified??
6. Were strategies to deal with confounding factors stated?
7. Were the outcomes measured in a valid and reliable way?
8. Was appropriate statistical analysis used?

Supplementary Table 6. Critical appraisal for analytical cross-sectional studies.

Study	1	2	3	4	5	6	7	8	Total
Armstrong & Oomen-Early 2009	X	X	X	X	X	X	X	X	8/8 (100%)
Bravata et al. 2002	X	X	X	X	NR	NR	X	UC	5/8 (62.5%)
Brenner et al. 2023	X	X	X	X	UC	UC	X	X	6/8 (75%)
Brown et al. 2021	X	X	X	X	X	X	X	X	8/8 (100%)
Bullard, J.B. 2020	X	X	X	X	X	X	UC	UC	6/8 (75%)
Chandler et al. 2021	X	X	X	X	X	X	X	X	8/8 (100%)
Christensen et al. 2021	X	X	X	X	X	X	X	X	8/8 (100%)
Covassin et al. 2014	X	X	X	X	X	X	X	X	8/8 (100%)
Covassin et al. 2019	X	X	X	X	NR	NR	X	X	6/8 (75%)
Cox et al. 2017	X	X	X	X	X	X	X	X	8/8 (100%)
de Souza et al. 2019	X	X	X	X	X	X	X	X	8/8 (100%)
Garver et al. 2021	X	X	X	X	NR	NR	X	X	6/8 (75%)
Hagiwara et al. 2017	X	X	X	X	X	X	X	X	8/8 (100%)
Lamb et al. 2017	X	X	X	X	NR	NR	X	X	6/8 (75%)
Leone et al. 2020	X	X	X	X	NR	NR	X	X	6/8 (75%)
Mikesell et al. 2023	X	X	X	X	UC	UC	X	X	6/8 (75%)
Powers et al. 2020	X	X	X	X	X	X	X	X	8/8 (100%)
Roby et al. 2021	X	X	X	X	NR	NR	X	X	6/8 (75%)
Sanborn et al. 2021	X	X	X	X	NR	NR	X	X	6/8 (75%)
Slavin et al. 2023	X	X	X	X	UC	UC	X	X	6/8 (75%)
Storch et al. 2002	X	X	X	X	NR	NR	X	UC	5/8 (62.5%)
Storch et al. 2004	X	X	X	X	NR	NR	X	UC	5/8 (62.5%)
Storch et al. 2005	UC	X	X	X	UC	UC	X	X	5/8 (62.5%)
Sullivan et al. 2020	X	X	X	X	X	X	X	X	8/8 (100%)
Tran, AGTT 2021	X	X	X	X	X	X	X	X	8/8 (100%)
Weber et al. 2023	X	X	X	X	UC	UC	X	X	6/8 (75%)
Wilson & Pritchard 2005	X	X	X	X	UC	UC	X	X	6/8 (75%)
Wilson et al. 2017	X	X	X	X	NR	NR	X	X	6/8 (75%)
Wolanin et al. 2016	X	X	X	X	NR	NR	X	X	6/8 (75%)
Total %	28/29 (97%)	29/29 (100%)	29/29 (100%)	29/29 (100%)	11/29 (38%)	11/29 (38%)	28/29 (97%)	26/29 (90%)	82.3%

Note. X – Yes; N – No; UC – Unclear; NR – Not Reported; N/A – Not Applicable

Joanna Briggs Quality Assessment Items

Quasi-experimental studies

1. Is it clear in the study what is the cause and what is the effect (i.e., there is no confusion about which variable comes first?)
2. Were the participants included in any comparisons similar?
3. Were the participants included in any comparisons receiving similar treatment/care other than exposure or intervention of interest?
4. Was there a control group?
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?
7. Were the outcomes of participants included in any comparisons measured in the same way?
8. Were outcomes measured in a reliable way?
9. Was appropriate statistical analysis used?

Supplementary Table 7. Critical appraisal for quasi-experimental studies.

Study	1	2	3	4	5	6	7	8	9	Total
Appaneal et al. 2009	X	X	X	X	X	X	X	X	X	9/9 (100%)
Evers et al. 2021	X	N	N	N	X	X	N/A	X	X	5/9 (55.5%)
Fogaca, Janaina L. 2018	X	X	X	X	X	X	X	X	X	9/9 (100%)
Total %	3/3 (100%)	2/3 (66.7%)	2/3 (66.7%)	2/3 (66.7%)	3/3 (100%)	3/3 (100%)	2/3 (66.7%)	3/3 (100%)	3/3 (100%)	85.2%

Note. X – Yes; N – No; UC – Unclear; NR – Not Reported; N/A – Not Applicable

Joanna Briggs Quality Assessment Items

Randomized controlled trials (RCTs)

1. Was true randomization used for assignment of participants to treatment groups?
2. Was allocation to treatment groups concealed?
3. Were treatment groups similar at baseline?
4. Were participants blind to treatment assignment?
5. Were those delivering treatment blind to treatment assignment?
6. Were outcome assessors blind to treatment assignment?
7. Were treatment groups treated identically other than the intervention of interest?
8. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?
9. Were participants analysed in the groups to which they were randomized?
10. Were outcomes measured in the same way for treatment groups?
11. Were outcomes measured in a reliable way?
12. Was appropriate statistical analysis used?
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

Supplementary Table 8. Critical appraisal for randomized control trials.

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Gross et al. 2003	X	N	X	N	N	X	X	X	X	X	X	X	X	10/13 (76.9%)
Total %	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	1/1 (100%)	76.9%

Note. X – Yes; N – No; UC – Unclear; NR – Not Reported; N/A – Not Applicable

Supplementary Table 9. Summary of critical appraisal tool used.

Study	**Year**	**Study Design**	**Joanna Briggs Quality Assessment Tool Used**
Anderson et al.	2023	Longitudinal	Checklist for Cohort Studies
Appaneal et al.	2009	Quasi-experimental	Checklist for Quasi-experimental Studies (non-randomized experimental studies)
Armstrong & Oomen-Early	2009	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Benjamin et al.	2020	Prospective Cohort Study	Checklist for Cohort Studies
Bravata et al.	2002	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Brenner et al.	2023	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Brown et al.	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Bullard, J.B.	2020	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Chandler et al.	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Christensen et al.	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Covassin et al.	2014	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Covassin et al.	2019	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Cox et al.	2017	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
de Souza et al.	2019	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Evers et al.	2021	Pilot Study/Quasi-experimental	Checklist for Quasi-experimental Studies (non-randomized experimental studies)
Fogaca, Janaina L.	2018	Quasi-experimental	Checklist for Quasi-experimental Studies (non-randomized experimental studies)
Garver et al.	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Graupensperger et al.	2020	Prospective Cohort Study	Checklist for Cohort Studies
Gross et al.	2003	Randomized Control Trial	Checklist for Randomized Controlled Trials
Guo et al.	2018	Prospective Cohort Study	Checklist for Cohort Studies
Hagiwara et al.	2017	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Kontos et al.	2012	Longitudinal	Checklist for Cohort Studies
Lamb et al.	2017	Pilot Study/Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Leone et al.	2020	Cross-sectional	Checklist for Analytical Cross-Sectional Studies

Mikesell et al.	2023	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Miller et al.	2002	Prospective Cohort Study	Checklist for Cohort Studies
O'Connor et al.	1989	Cohort Study	Checklist for Cohort Studies
Pierce, E. F., Jr.	2002	Prospective Cohort Study	Checklist for Cohort Studies
Powers et al.	2020	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Raglin et al.	1993	Prospective Cohort Study	Checklist for Cohort Studies
Roby et al.	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Roiger et al.	2015	Descriptive Epidemiologic Study/Cohort Study	Checklist for Cohort Studies
Sanborn et al.	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Slavin et al.	2023	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Storch et al.	2005	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Storch et al.	2004	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Storch et al.	2002	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Sullivan et al.	2020	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Sullivan et al.	2022	Prospective Cohort Study	Checklist for Cohort Studies
Tobar, David A.	2012	Prospective Cohort Study	Checklist for Cohort Studies
Tomlinson et al.	2021	Prospective Observational Study	Checklist for Cohort Studies
Tran, AGTT	2021	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Turner et al.	2017	Prospective Cohort Study	Checklist for Cohort Studies
Valster et al.	2022	Nonexperimental Trend Study/Cohort Study	Checklist for Cohort Studies
Vargas et al.	2015	Case-control	Checklist for Case-Control Studies
Weber et al.	2018	Prospective Cohort Study	Checklist for Cohort Studies
Weber et al.	2023	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Wilson & Pritchard	2005	Cross-sectional	Checklist for Analytical Cross-Sectional Studies
Wilson et al.	2017	Cross-sectional Observational	Checklist for Analytical Cross-Sectional Studies
Wolanin et al.	2016	Prospective Cohort Study	Checklist for Cohort Studies
Yang et al.	2014	Cohort Study	Checklist for Cohort Studies
Yang et al.	2007	Prospective Cohort Study	Checklist for Cohort Studies

Supplementary Table 10. PRISMA Abstract Checklist.

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesise results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	Yes
Registration	12	Provide the register name and registration number.	Yes

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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Supplementary Table 11. PRISMA Checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Supplemental Table 10
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Lines 1-47
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Lines 48-55
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Lines 73-85
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Lines 64-71; Supplemental Table 1
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplemental Table 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Lines 87-93; Supplemental Table 1
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Lines 57- 62; Supplemental Table 1
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Lines 106-112; Supplemental Tables 2-3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Supplemental Tables 2-3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Lines 95-104

Section and Topic	Item #	Checklist item	Location where item is reported
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Supplemental Figures 1-3
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Lines 118-125
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Lines 126-129
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Lines 131-133
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Lines 126-137
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Lines 135-137
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Lines 116-133
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Lines 95-104
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Lines 126-129
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Figure 1
Study characteristics	17	Cite each included study and present its characteristics.	Supplemental Tables 2-3
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Supplemental Tables 4-9
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Supplemental Figures 1-3
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Supplemental Tables 2-9

Section and Topic	Item #	Checklist item	Location where item is reported
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Lines 346-357
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Lines 358-368
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Lines 360-368
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Lines 370-378
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Lines 386-395
	23b	Discuss any limitations of the evidence included in the review.	Lines 442-496
	23c	Discuss any limitations of the review processes used.	Lines 442-496
	23d	Discuss implications of the results for practice, policy, and future research.	Lines 396-440
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Line 62
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Line 62
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Additional page
Competing interests	26	Declare any competing interests of review authors.	Additional page
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Supplemental Tables 1-9

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