LUND UNIVERSITY

Mental health in elite sports: Epidemiology, risk factors, and treatment experiences

Andersson, Mitchell

2025

Document Version:
Publisher's PDF, also known as Version of record

Link to publication

Citation for published version (APA):
Andersson, M. (2025). *Mental health in elite sports: Epidemiology, risk factors, and treatment experiences.* [Doctoral Thesis (compilation), Department of Clinical Sciences, Lund]. Lund University, Faculty of Medicine.

Total number of authors:
1

General rights
Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.
• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: https://creativecommons.org/licenses/

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Download date: 18. Dec. 2025

Mental health in elite sports

Epidemiology, risk factors, and treatment experiences

MITCHELL J. ANDERSSON
CLINICAL SCIENCES LUND | FACULTY OF MEDICINE | LUND UNIVERSITY

Mental health in elite sports: Epidemiology, risk factors, and treatment experiences

Mental health in elite sports

Epidemiology, risk factors, and treatment experiences

Mitchell J. Andersson

LUND
UNIVERSITY

DOCTORAL DISSERTATION

Doctoral dissertation for the degree of Doctor of Philosophy (PhD) at the Faculty of Medicine at Lund University.
To be publicly defended at Belfragesalen, BMC D15, Klinikgatan 32, 223 62, Lund, May 15th, 2025, at 9:00am

Faculty opponent
Professor Vincent Gouttebarge
Amsterdam University Medical Center
Amsterdam, Netherlands

Organization: LUND UNIVERSITY

Document name: Doctoral Dissertation **Date of issue:** 2025-04-07

Author(s): Mitchell J. Andersson **Sponsoring organization:**

Title and subtitle: Mental health in elite sports: Epidemiology, risk factors, and treatment experiences

Abstract: In the context of elite sports, promoting mental health has been long driven by the desire to optimize training and performance, sometimes at the expense of the individual's well-being and longevity. In these settings, both athletes and support staff navigate an intricate web of physical, psychological, and social stressors that can enhance or compromise their mental health, potentially engendering the development of adverse symptoms and psychiatric disorders. The aim of this thesis was to investigate the prevalence of common adverse mental health symptoms among diverse elite sports populations, to identify associated risk factors—specifically COVID-19 and sports-related concussion—and to explore the help-seeking and treatment experiences of those involved in elite sports.

This research comprised several complementary studies. Study I employed a repeated cross-sectional design, analyzing 13,249 observations from elite student-athletes enrolled in national and regional programs across Sweden during 2021 and 2022, in order to assess changes in depressive and anxiety symptoms during versus after the COVID-19 pandemic. Studies II and III utilized cross-sectional designs involving 648 and 628 elite ice hockey athletes from Sweden's premier male and female leagues to examine the prevalence of elevated mental health symptoms and their association with sports-related concussions. Study IV combined qualitative interviews with a retrospective journal review, analyzing data from 96 patients at a sports-specialized outpatient psychiatric clinic and conducting semi-structured interviews with 15 participants varying in sex, diagnosis, age, and sport.

Findings revealed a modest reduction in elevated depressive symptoms among student-athletes following the easing of COVID-19 restrictions. Among elite ice hockey players, a positive correlation was observed between the frequency of sports-related concussions and the severity of depressive, anxiety, and burnout symptoms. Meanwhile, male elite ice hockey players endorsed high levels of problem gambling behavior, nearly four times that seen in males of similar age from the general population. Additionally, a range of factors was identified that both undermined athletes' mental health and impeded their propensity to seek care. Collectively, these results underscore the multifaceted and complex risk environment inherent to elite sports, highlighting differences in how these stressors may be experienced relative to non-athlete populations.

Key words: COVID-19, sports-related concussion, traumatic brain injury, treatment-seeking, psychiatry

Classification system and/or index terms (if any) Supplementary bibliographical information

Language: English **Number of pages**: 95

ISSN and key title: 1652-8220

ISBN: 978-91-8021-711-8

Recipient's notes Price Security classification

I, the undersigned, being the copyright owner of the abstract of the above-mentioned dissertation, hereby grant to all reference sources permission to publish and disseminate the abstract of the above-mentioned dissertation.

Signature Date 2025-04-07

Mental health in elite sports

Epidemiology, risk factors, and treatment experiences

Mitchell J. Andersson

LUND
UNIVERSITY

Coverphoto by Mitchell J. Andersson & Sanna Treptow
Copyright 2025 pp 1-95 Mitchell J. Andersson

Paper 1 © Informa UK Ltd (Open Access)
Paper 2 © Springer Nature (Open Access)
Paper 3 © Informa UK Ltd (Open Access)
Paper 4 © by the Authors (Manuscript unpublished)

Clinical Sciences Lund, Faculty of Medicine
Department of Psychiatry

ISBN 978-91-8021-711-8
ISSN 1652-8220
Printed in Sweden by Media-Tryck, Lund University
Lund 2025

Media-Tryck is a Nordic Swan Ecolabel certified provider of printed material. Read more about our environmental work at www.mediatryck.lu.se

MADE IN SWEDEN

To Doreen

Table of Contents

Popular science summary (populärvetenskaplig sammanfattning)

En betydande andel av världens befolkning har under sin livstid utövat någon form av idrott, och ännu fler engagerar sig genom att följa elitidrott på högsta nivå. Många identifierar sig med ett specifikt lag eller enskild idrottsutövare, och bidrar därmed till en idrottskultur där framgång ofta mäts genom seger och där individens prestation ställs i centrum. Redan från ung ålder idealiseras idrottsstjärnor och drömmen om en framgångsrik idrottskarriär blir en drivkraft. Under barndomen präglas tävlandet ofta av glädje och lekfullhet, men när ambitionen att satsa på en elitidrottskarriär tar form, möter individen en verklighet där ökad press, hård konkurrens, tidig selektion och utslagning blir vardag. Med ett begränsat antal platser inom varje lag eller förbund intensifieras kravet på att ständigt prestera på toppnivå. Denna konkurrens medför att idrottsutövare tvingas träna allt hårdare för att säkra sin plats, vilket i sin tur medför utmaningar längs vägen mot toppen. Avhandlingen fokuserar på denna resa, med särskilt intresse för de stressfaktorer som påverkar individers psykisk hälsa inom elitidrott.

Begreppet stress kan förstås utifrån graden av kontroll över sin omgivning – ju större kontroll, desto mindre stress upplevs vid utmanande situationer. Kortvarig stress kan fungera som en positiv drivkraft, men långvarig eller överdriven stress medför risker för allvarlig psykisk ohälsa, såsom depression, ångest, utbrändhet och i vissa fall missbruk av substanser. I denna avhandling diskuteras flera aktuella stressfaktorer med särskild relevans för elitidrott: COVID-19-pandemin, som från 2020 påverkat samhällen globalt, samt idrottsrelaterade hjärnskakningar, en skada som idrottsutövare löper en hög risk att drabbas av under sin karriär. COVID-19 och hjärnskakningar kan leda till biologiska förändringar genom sjukdom eller skada och påverka den upplevda kontrollen över miljön, vilket i sin tur ökar den psykiska stressen.

Genom en serie studier undersöks dessa samband empiriskt. I den första studien distribuerades en enkät till elitsatsande idrottsgymnasieelever vid riksidrottsgymnasium (RIG) och nationellt godkända idrottsutbildningar (NIU) skolor, med totalt 13 249 svar insamlade under perioden 2021–2022. År 2021 präglades av radikala förändringar i vardagen till följd av COVID-19-pandemin, medan 2022 kännetecknades av massvaccination och ett avskaffande av restriktioner. Förväntningarna var att en återgång till normala förhållanden skulle medföra en betydande minskning av depressiva och ångestsymtom, vilket delvis bekräftades genom en statistiskt signifikant men måttlig minskning av depressiva symtom, medan ångestsymtomen förblev oförändrade.

I den andra studien genomfördes en enkät bland elitishockeyspelare i Swedish Hockey League (SHL), HockeyAllsvenskan och Svenska damhockeyligan (SDHL), med 648 svar från både manliga och kvinnliga utövare. Här ingick frågor om

frekvensen av slag mot huvud – potentiellt indikatorer på hjärnskakningar – samt om psykiskt mående. Resultaten visade att manliga hockeyspelare generellt rapporterade bättre psykiskt mående jämfört med både andra elitidrottare och den allmänna befolkningen, medan kvinnliga hockeyspelare uppgav högre nivåer av utbrändhet. Dessutom noterades en högre förekomst av problematisk alkoholkonsumtion bland elitishockeyspelare, vilket kan spegla en kultur med positiv inställning till alkohol inom sporten. Korrelationer mellan antal hjärnskakningar och symtom på depression, ångest samt utbrändhet var särskilt starka.

I den tredje studien analyserades samma data med fokus på problemspelande. Bland de 628 deltagare som besvarade frågorna uppgav nästan 12 % av de manliga idrottarna symtom inom den moderata riskzonen för problemspelande – en frekvens som var över fyra gånger högre än i den allmänna befolkningen. Dessa symtom var förknippade med alkoholkonsumtion, depression och ångest, medan variabler som ålder, antal hjärnskakningar och spelfrekvens inte visade någon likvärdig association. Inga motsvarande mönster framkom bland de kvinnliga utövarna, vilket tyder på att kulturella och strukturella faktorer inom herrishockeyn kan spela en roll i utvecklingen av problemspelande.

I den fjärde studien genomfördes en retrospektiv journalgenomgång av patienter som sökt vård vid den vuxenpsykiatriska mottagningen för elitidrott och hälsa i Malmö. Data från 96 patienter, varav majoriteten var kvinnor och aktiva idrottsutövare, analyserades. De flesta patienter diagnostiserades med depression, ångest eller ätstörningar. För att fördjupa förståelsen av patienternas erfarenheter genomfördes även semistrukturerade intervjuer med 15 patienter från olika idrotter, åldersgrupper och med varierande diagnoser. Intervjuerna belyste en rad personliga, idrottsrelaterade och externa faktorer som både bidrog till respektive hindrade en optimal psykisk hälsa, samt identifierade hinder och möjliggörare i processen att söka hjälp. Trots att samtliga deltagare uttryckte nöjdhet med den vård de erhållit, föreslogs flera förbättringar för att bättre anpassa behandlingen till elitidrottares specifika behov.

Sammanfattningsvis undersöker denna avhandling hur psykisk ohälsa manifesteras inom elitidrott, vilka faktorer som påverkar idrottsutövarnas psykiska hälsa, samt hur vårdprocessen ser ut för denna population. Genom att bidra med nya empiriska insikter syftar arbetet till att stimulera diskussionen kring hur elitidrottsmiljöer kan utformas för att stödja både hög prestationsförmåga och långsiktig psykisk hälsa.

List of papers

Paper I (Study I)

Andersson, M. J., Kenttä, G., Moesch, K., Borg, E., Claesdotter-Knutsson, E., & Håkansson, A. (2023). Symptoms of depression and anxiety among elite high school student-athletes in Sweden during the COVID-19 pandemic: A repeated cross-sectional study. *Journal of sports sciences*, *41*(9), 874-883. https://doi.org/10.1080/02640414.2023.2241783

Paper II (Study II)

Andersson, M. J., Kenttä, G., Claesdotter-Knutsson, E., & Håkansson, A. (2024). Mental health symptom burden in elite ice hockey players and its association with self-reported concussive events. *BMC Sports Science, Medicine and Rehabilitation, 16*(1), 197. https://doi.org/10.1186/s13102-024-00989-0

Paper III (Study III)

Håkansson, A., **Andersson, M. J.**, Claesdotter-Knutsson, E., & Kenttä, G. (2025). Problem gambling among elite ice hockey players in Sweden–elevated prevalence among male, but not female athletes. *The Physician and Sportsmedicine*. https://doi.org/10.1080/00913847.2025.2473874

Paper IV (Study IV)

Andersson, M. J., Rahim, Y. A., Kenttä, G., Håkansson, A., Claesdotter-Knutsson, E. (under review). Mental health challenges in elite sports, barriers to treatment, and quality of psychiatric care at an elite sports-centered mental health clinic—a mixed-methods study. *Psychology of Sport and Exercise.*

Key abbreviations

ACRM	American Congress for Rehabilitation Medicine
APA	American Psychiatric Association
AUDIT-C	Alcohol Use Disorder Identification Test-Consumption
BSMAS	Bergen Social Media Addiction Scale
CBT	Cognitive behavioral therapy
CISG	Concussion in Sport Group
COVID-19	Coronavirus disease 2019
DSM	Diagnostic and Statistical Manual of Mental Disorders
GAD	Generalized Anxiety Disorder (questionnaire)
GCS	Glascow Coma Scale
HA	HockeyAllsvenskan
ICD	International Classification of Diseases
LOC	Loss of consciousness
PGSI	Problem Gambling Severity Index
PHQ	Patient Health Questionnaire
PTA	Post-traumatic amnesia
RTL	Return-to-learn
RTS	Return-to-sport
SDT	Self-determination theory
s-ES	Self-Reported Exhaustion Syndrome questionnaire
SHL	Swedish Hockey League
SICO	Swedish ice hockey players' union
SRC	Sports-related concussion
SWHL	Swedish Women's Hockey League
TBI	Traumatic brain injury
TPB	Theory of planned behavior
TTI	Theory of triadic influence
WHO	World Health Organization

Introduction

Mental health

Interest in research concerning mental health in high-performance sporting contexts has surged over past decades, driven by the integral link between mental health and athletic performance[1-2]. While exercise and sports participation are known to have positive effects on physical and mental health, mental health itself is a broad and complex concept. In this thesis, I explore definitions and theories that shape our understanding of mental health and mental illness—what they might be, what they might not be, and how they are influenced and expressed in the realm of elite sport. Since mental health and illness encompass a broad spectrum of experiences and conditions, this thesis pragmatically focuses on a select set of adverse mental health symptoms deemed particularly relevant and prevalent in elite sports settings. Our discussion will entail a general overview before delving into the specific context of sport, acknowledging that, at their core, athletes are human too.

Definitions of mental health and classification

Our conceptualization and definition of "mental health" and its counterpart "mental illness" have continuously evolved over time. As evidenced by definitions dawned by the World Health Organization (WHO), the American Psychological Association, and the American Psychiatric Association (APA) seen in Table 1, incongruencies persist today. Specifically, definitions from the WHO and the American Psychological Association include well-being as a quintessential component of mental health, while the APA definition does not. Nevertheless, each of their definitions for both constructs appear to serve as umbrella terms that encompass conditions associated with one's emotions, thoughts, and behavior. Like the APA, many argue that mental health is not merely the absence of mental disorder, nor merely the presence of well-being[3], defining mental health as, "the capacities of each and all of us to feel, think, and act in ways that enable us to value and engage in life." (pp. 698). This definition places mental health and well-being on distinct, yet interrelated, continua.

Table 1. Definitions of mental health and mental illness/disorder

Entity	Definition of mental health	Definition of mental illness/disorder
World Health Organization	"Mental health is a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community"[4]	"A mental disorder is characterized by a clinically significant disturbance in an individual's cognition, emotional regulation, or behavior"[5]
American Psychological Association	"A state of mind characterized by emotional well-being, good behavioral adjustment, relative freedom from anxiety and disabling symptoms, and a capacity to establish constructive relationships and cope with the ordinary demands and stresses of life"[6]	"Any condition characterized by cognitive and emotional disturbances, abnormal behaviors, impaired functioning, or any combination of these. Such disorders cannot be accounted for solely by environmental circumstances and may involve physiological, genetic, chemical, social, and other factors. Specific classifications of mental disorders are elaborated in the APA's DSM"[7]
American Psychiatric Association[8]	"Mental Health involves effective functioning in daily activities resulting in: (1) Productive activities (such as in work, school or caregiving), (2) Healthy relationships, and (3) Ability to adapt to change and cope with adversity."	"Mental Illness...refers collectively to all diagnosable mental disorders — health conditions involving: (1) Significant changes in thinking, emotion and/or behavior, (2) Distress and/or problems functioning in social, work or family activities."

Note. Quotations modified to fit table format. APA = American Psychiatric Association. DSM = Diagnostic and Statistical Manual of Mental Disorders.

Various tools and approaches have been developed to measure mental health constructs in clinical and general populations, including diagnostic criteria and survey-based measures. Epidemiological estimates of mental health disorders often rely on diagnostic data typically based on two primary classification systems: the APA's Diagnostic and Statistical Manual of Mental Disorders (DSM) and the WHO's International Classification of Diseases (ICD). As of 2025, the most recent editions are the DSM-5-TR[9] and ICD-11[10]. While diagnostic data are considered the gold standard due to their reliance on clinical judgment by trained professionals, it may underestimate the true prevalence of mental health disorders because many individuals in need of clinical intervention do not seek treatment[11-12]. To add, shifts in cultural attitudes toward mental health, changes in medical practice, and evolving diagnostic criteria (e.g., Swedish ICD-10 inclusion of exhaustion syndrome as a medical diagnosis) can further obfuscate these prevalence estimates.

These classification systems distinguish between normal and abnormal mental states, a long-standing tradition in psychology and psychiatry that has faced

criticism[13]. A key limitation is their lack of reliability, as most classified psychiatric disorders do not have consistently measurable neurobiological markers and instead rely primarily on diagnostic interviews. In response, alternative models—such as spectrum and dimensional approaches—have been proposed. These models reject binary classifications in favor of a continuum-based framework, recognizing mental health as a dynamic construct where symptoms exist along a spectrum and can be assessed and treated accordingly. One emerging framework in psychopathology research is the Hierarchical Taxonomy of Psychopathology (HiTOP). The HiTOP model is structured hierarchically, with a general latent factor, *p*, underlying all forms of psychopathology. From this broad factor, increasingly specific clusters emerge, progressing from overarching spectra to syndromes and, ultimately, to distinct symptoms and behaviors[14]. While HiTOP and similar models offer a nuanced and dimensional approach to understanding mental disorders, it also presents several challenges, including diagnostic ambiguity, dearth of standardization, and the risk of overpathologizing adverse mental health symptoms.

In parallel to diagnostic models, psychometric measures are frequently used in both research and clinical settings to estimate the prevalence of mental health disorders and related symptoms[15]. These measures, sometimes based on diagnostic models or adapted for specific populations, can provide broader reach and capture subclinical symptoms. However, unlike diagnostic data, survey-based measures face several challenges to validity and reliability, including self-report bias and inconsistent test-retest reliability.

Athletes: Who are they?

Analogous to the evolving conceptualization of "mental health," the definition of an "athlete" and “eliteness” has likewise generated substantial scholarly discussion. McKinney and colleagues[16] define competitive athletes as individuals who not only intend to compete but also commit to a minimum of six hours of training per week and engage in organized competitions sanctioned by athletic associations. Building on this foundation, Swann and colleagues[17] offer a straightforward framework for assessing eliteness (i.e., the relative level of competition)—by considering five criteria: (1) the athlete’s highest attained performance level, (2) the degree of success achieved at that level, (3) the duration of experience at the peak level, (4) the relative competitiveness of the sport within the athlete’s country, and (5) the global competitiveness of the sport.

At the highest levels of competition, athletes dedicate copious hours to training and competing, resulting in physiological profiles that are distinct from those of non-athletes and that vary across different sports[18]. Moreover, genetics appear to place an upper limit on performance capacity, reinforcing biological disparities between athletes and non-athletes, as those with greater genetic tolerability are more likely to achieve elite athletic status[19]. This divergence extends to the economic sphere. Unlike non-athletes, whose careers typically follow a gradual and prolonged income

trajectory, professional athletes often experience a sharp rise in earnings over a short period, followed by a rapid decline. This peak earning phase—often occurring in early adulthood—may coincide with limited financial literacy. Consequently, inadequate financial planning and the transient nature of elite athletic careers heighten the risk of financial insecurity and psychological distress upon approaching retirement, prompting growing efforts to enhance athletes' financial literacy and promote long-term financial stability[20-21].

While physical and genetic attributes alongside short-term economic advantage may delineate athletes from non-athletes, the psychological differences between these groups are equally noteworthy. Research suggests that athletes tend to exhibit distinct personality profiles compared to non-athletes[22]. Athletes tend to report higher levels of extraversion and agreeableness, while elite-level athletes, specifically, tend to be more conscientious and less neurotic than their both non-elite and non-athlete counterparts[23]. Athletes also exhibit greater sensation-seeking tendencies and risk-taking behavior, traits that may facilitate peak performance but simultaneously increase vulnerability to maladaptive outcomes such as substance use and injury[22]. Another salient psychological trait among athletes is their enhanced perceived self-efficacy[24], defined as one's perceived capability to successfully execute tasks and behavior[25]. This may foster resilience and improve performance outcomes, but excessive levels may also exacerbate perfectionistic tendencies. The drive for perfectionism observed among sportspeople can enhance performance but augment the athlete's susceptibility to adverse psychiatric outcomes when faced with insurmountable demands to maintain perfection[22].

What athletes and sports staff perceive as stressful and how they cope with these challenges may also differ from that of non-sportspeople. Arnold and Fletcher[26] identified 640 unique organizational stressors encountered by sports performers, many of which are unique to their context. They classified them into four categories of stressors concerning leadership and personnel (e.g., excessive media attention), culture and team (e.g., poor communication), logistics and sporting environment (e.g., excessive travel), and personal challenges that undermine performance and health (e.g., retirement support). Some research suggests that athletes may be more likely to deploy problem-focused coping strategies, which are generally more effective at alleviating stress. However, they may also exhibit avoidant or confrontational coping styles, which can exacerbate psychological distress and contribute to poor mental health outcomes in some situations[27-30].

The type of sport and underlying motivation for competition may further shape athletes' psychological profiles. Individual-sport athletes tend to exhibit greater extraversion and openness compared to team-sport athletes[23,31]. They are also more likely to report that they compete for achievement-based motives rather than for recreation[31], which could increase the level of stress that individual-sport athletes place upon themselves if factors outside of their control are perceived to hinder them from achieving their personal goals.

Another key psychological factor unique to athletes is the "athlete identity", that is, the extent to which athletes define themselves in relation to their athletic role. Strong athlete identity may bolster performance and dedication but may also increase the risk of maladaptive behaviors (e.g., overtraining, performance-enhancing drug-use)[22]. Moreover, a rigid adherence to athlete identity may complicate the transition out of sport—whether prompted by injury, retirement, or deselection—posing significant psychological challenges[32]. Together, these findings illustrate that athletes are not merely distinguished by their physical prowess, but also by a constellation of psychological traits that both enable and challenge their pursuit of excellence. Understanding these psychological dimensions is essential for detecting and treating mental health issues that arise in those engaged in elite sports.

Psychiatric epidemiology

Utilizing diagnostic criteria from the DSM and the ICD, as well as psychometric instruments, we are able to estimate the prevalence of mental health disorders and symptoms in various populations. In Figure 1, I present prevalence rates of common mental health and substance use disorders around the world and in Sweden across all ages based on ICD-10 diagnostic criteria from the GBD study[33].

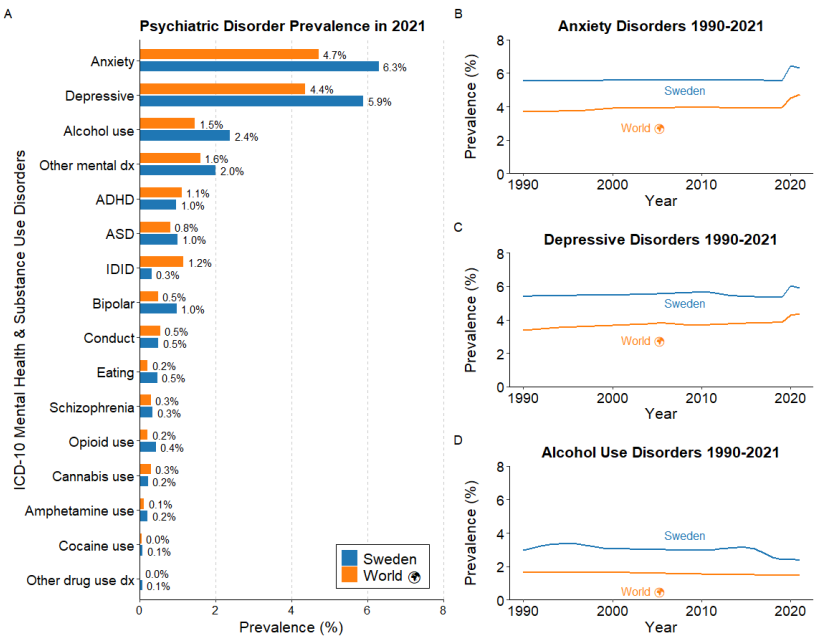

Figure 1. Point prevalence of common mental health and substance use disorders
Data from the GBD study[33]. (A) point prevalence of psychiatric disorders in Sweden and World from 2021 (B-D) point prevalence from 1990-2021 for anxiety, depressive, and alcohol use disorders in Sweden and World. IDID = idiopathic developmental intellectual disability; ADHD = attention deficit hyperactivity disorder; ASD = autism spectrum disorder.

In Sweden and globally, anxiety, depressive, and alcohol use disorders were most common as of 2021 and rates have been relatively stable since 1990. Yet, prevalence rates differ across groups due to various factors[34], and diagnostic data can sometimes underestimate true rates—especially for conditions with evolving criteria (e.g., burnout, gambling disorder). Survey studies therefore play a vital role in revealing overall symptom burden. For instance, Johansson and colleagues[35], using the Patient Health Questionnaire (PHQ-9) and the Generalized Anxiety Disorder questionnaire (GAD-7), found that 17% of residents in Sweden reported clinically significant symptoms of depression and/or anxiety. Similarly, a 2024 study by the Swedish Ministry of Health[36], which employed the Alcohol Use Identification Test (AUDIT) and the Problem Gambling Severity Index (PGSI), reported that 16% of Swedes aged 16 and older engaged in hazardous drinking, while approximately 3% of young adults exhibited problem gambling behavior.

Among elite athletes, prevalence studies generally show rates comparable to the general population, though certain outcomes are notably different[37-39]. One Swedish study indicated that, similar to the general population, 20% of elite athletes in their sample ($N = 333$) experienced clinically significant anxiety and/or depression, with 26% reporting hazardous drinking[40]. In contrast, a Canadian study found that over 38% of their sample of elite athletes ($N = 186$) endorsed clinically significant levels of depression and/or anxiety[41]. Other outcomes found to be more common among elite athletes include eating disorders and problem gambling, which may be linked to athletes' increased competitiveness and perfectionistic tendencies[40,42-44].

Etiological theory

There is a multitude of contemporary etiological theories and models that explain the development of mental health problems[45]. A brief historical overview of the evolving waves of theory offers insight into how we understand psychiatry today. Early modern psychiatric theories held strong biological stances[46]. Reinvented by Kraepelin in the late 19th century, early biological psychiatrists emphasized brain pathology (i.e., chemical imbalances) as the most relevant mechanism underpinning mental illness. Freud's iconoclastic psychodynamic theory (1890s) challenged the validity of early biological mechanisms by emphasizing the importance of childhood experiences and the unconscious[47]. Later, behaviorism, championed by Watson, Pavlov, and Skinner in the early 20th century, shifted the focus to environmental influences, asserting that learning, rather than innate traits, drove behavior that could be modified accordingly[46]. In contrast, Vygotsky's concurrent sociocultural theory (1920s) argued for the importance of social context and cultural history, illustrating how past deprivation, trauma, and cultural factors influence mental health. Building on this, Rogers and Maslow's humanistic theories (1940s–1960s) emphasized the importance of self-actualization and individual potential in mental health, postulating that incongruence between self-concept and ideal self, a

dearth of positive regard, and inhibited personal growth laid the foundation for the development of poor mental health. Meanwhile, Beck and Lazarus' contributions to cognitive theory (1960-1980s), in contrast to psychodynamic theory, linked mental illness to maladaptive thought patterns. Later, Engel's biopsychosocial model from the 1970s, grounded in health psychology, synthesized these perspectives, emphasizing the interplay of biological, psychological, and social factors. Subsequently, Kandel's work in neurodevelopmental and epigenetic theory (1980s) built on this by demonstrating the role of gene-environment interactions, while Bronfenbrenner's ecological systems theory (1990s) underscored the importance of environmental layers in shaping an individual's mental health[46].

As mental health theories evolved, so too did our understanding of substance use disorders and addiction, which has similarly been shaped by a variety of etiological models and frameworks. The evolution of addiction's conceptualization enjoys a rich history of etiological theory, as exemplified in changing diagnostic criteria in the DSM over time[48]. Already in the DSM-I, addiction was portrayed as a brain syndrome, albeit represented as a subcomponent of a personality disorder. Thereafter, the DSM-II shifted toward a more independent disorder, while the DSM-III introduced distinct categories for substance abuse and dependence—emphasizing withdrawal and tolerance. The subsequent DSM-III-R broadened the definition to include both physiological and behavioral symptoms. Later, the DSM-IV reclassified these as substance-related disorders, retaining the concepts of abuse and dependence, until the DSM-V, which solidified its stance that addiction is fundamentally a neurobiological phenomenon, incorporated gambling disorder as the first non-substance-related addictive condition, and eliminating the concept abuse/dependence as well as the term "addiction" to eschew its negative connotations[48].

Today, there are primarily two conflicting perspectives to the etiology of addiction, the brain disease model[49-51] and learning/choice theories[52-54]. The former model, primarily driven by a biomedical perspective, postulates that addiction constitutes a subgroup of individuals with severe substance use disorders who experience a chronic, relapsing brain disease undermining free will as a result of neurobiological alterations in brain function and structure precipitated by prolonged substance use[49-51]. They highlight alterations in neuronal circuitry underlying the mesolimbic dopaminergic reward pathways involving the prefrontal cortex, ventral tegmental area, nucleus accumbens, amygdala, hippocampus, insula, and dorsal striatum. These changes drive the intensity of bingeing and intoxication from drug use, the severity of withdrawal and negative affect, and the degree of preoccupation and anticipation before the next use. Proponents often draw upon evidence from (1) neuroimaging studies revealing differences in structure and function of those with addiction (2) high relapse rates as evidence of these irreversible changes to neural circuitry, and (3) a high proportion of variance that is explained by predisposing

genetic factors[49]. Meanwhile, other theories, primarily driven by behavioral and sociocultural perspectives, challenge this model, positing that addiction is a result of socially learned behavior rather than a disease process[52-54]. Advocates for these theories highlight that a large majority of individuals overcome addiction without formal medical treatment, and that other factors are more likely to modulate addictive behavior than neurobiological and genetic factors. These theories underscore the importance of addressing motivation and self-efficacy and frequently draw upon behavior change frameworks, such as Prochaska and Velicer's[55] transtheoretical model of behavior change, to guide interventions.

Applied etiological theory to sports psychiatry

In the realm of sports, various applied theories have been developed to explain the emergence of adverse mental health symptoms among athletes. Contemporary models can be categorized into single-continuum/stage, dual-continuum, and holistic/ecological models[56].

Single-continuum models, which position mental health on a spectrum from no impairment to severe impairment, have been met with criticism within sports psychology. Critics argue that such models fail to differentiate between natural responses to everyday stressors and the emergence of clinically significant mental health symptoms[56]. This limitation has led to the increasing adoption of dual-continuum models, including that of Uphill and colleagues[57], which has been further applied by Küttel and colleagues[58]. These models posit the existence of two distinct but related continua: one representing mental illness and the other mental health. Grounded in positive psychology, this perspective suggests that mental illness and mental well-being have separate etiologies, meaning that an athlete can be free from mental illness yet still experience low psychological well-being. Movement along these continua is influenced by sport-specific stressors—such as performance pressure, injury, and overtraining—as well as systemic factors, including stigma surrounding mental health in sport.

More recent theoretical advancements have favored holistic and ecological approaches, such as Stevens and colleagues'[59] Social Identity Model of Athlete Mental Health and Henriksen and colleagues'[60] Team Denmark Applied Model of Athlete Mental Health. The former, rooted in social identity theory, posits that mental health and mental ill health in athletes are shaped by the strength and nature of their social identities[59]. Strong, positive social identities act as psychological resources that fulfill essential needs for belonging, meaning, and support, fostering resilience and well-being. Conversely, an overreliance on a singular athletic identity or the erosion of broader social connections—particularly during key transitions such as injury, club changes, or retirement—can heighten vulnerability to stress and mental health challenges. This model further highlights the role of leadership in shaping an athlete's self-concept, emphasizing that leaders who cultivate a shared

sense of "us" can protect and promote mental health in the high-pressure context of elite sport.

Similarly, Henriksen and colleagues'[60] model adopts a holistic, ecological perspective, acknowledging that mental health is influenced by multiple layers of an athlete's environment. These include individual experiences, training conditions (including team dynamics), leadership quality, and everyday life beyond sport. This model posits that optimal mental health is achieved when athletes train in psychologically safe environments under supportive leadership while maintaining balanced lives outside of sport. Conversely, when athletes experience toxic leadership, high-pressure training conditions, and an unbalanced personal life, they enter a "risk-zone" where they become vulnerable to stressors, necessitating early intervention and screening. In extreme cases, where detrimental leadership and chaotic life circumstances prevail, athletes may develop severe mental health challenges, requiring immediate treatment and systemic restructuring.

Beyond these broad frameworks, specific models addressing particular mental health concerns in sport also exist—such as Gustafsson et al.'s[61] Integrated Athlete Burnout Model and Petrie & Greenleaf's[62] Sociocultural Model of Disordered Eating. While these models provide valuable insights into targeted mental health outcomes, they may be overly narrow in scope and, at times, misaligned with broader, multidimensional theories.

Models of psychiatric treatment-seeking

The progression from the development of adverse mental health symptoms to the decision to seek treatment underscores a critical phase in the life cycle of mental illness. The number of individuals seeking care for psychiatric symptoms is notably lower than those reporting clinically significant symptoms, highlighting a substantial treatment gap[11-12]. Several models have been developed to explain the process of intention and subsequent behavior, which can be generalized to the process of help-seeking. A foundational model is the Theory of Planned Behavior (TPB), first proposed by Ajzen[63]. This theory builds upon self-efficacy and social cognitive theory, extending the Theory of Reasoned Action[64]. TPB incorporates elements from the Theory of Reasoned Action, such as attitudes—the feelings one holds toward a behavior—and subjective norms, which refer to an individual's perceptions of relevant social groups' attitudes toward that behavior. TPB further extends these constructs by introducing self-efficacy and perceived behavioral control[65], concepts originally developed by Bandura[25,66]. Self-efficacy refers to one's belief in their ability to execute a behavior, while perceived behavioral control relates to the individual's sense of control over successfully carrying out that behavior. These foundational concepts have been integrated into broader frameworks, such as the Theory of Triadic Influence (TTI[67]), which includes these

constructs as proximal predictors of decisions and intentions to engage in a particular behavior (Figure 2).

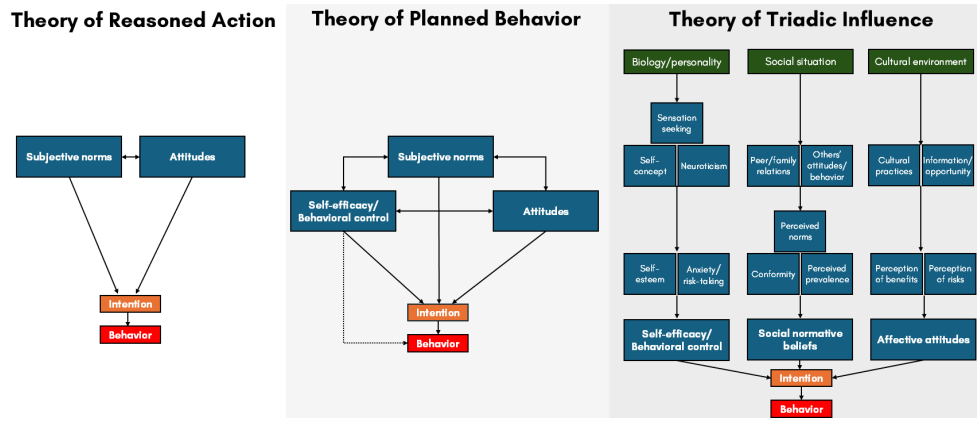

Figure 2. Social-cognitive theories predicting health-related behavior

While TPB and related frameworks emphasize psychosocial factors that can either impede or facilitate mental health treatment seeking, the TTI expands this focus by considering the broader context, incorporating biological predispositions alongside societal and cultural influences. Another model often employed is Self-Determination Theory (SDT), developed by Deci and Ryan[68-69], which is grounded in humanistic psychology and motivational theory. SDT emphasizes the role of intrinsic motivation and the fulfillment of psychological needs in fostering well-being and self-actualization. These frameworks may be highly relevant to the treatment-seeking process when applied to the sporting context[70].

Psychiatric treatment

Clinicians have a wide range of evidence-based treatments at their disposal within psychiatry, including pharmacotherapies, psychotherapies, or a combination. Below are some examples for first-line treatment options for three of the most common mental health outcomes: anxiety, depression, and alcohol use disorders. For anxiety disorders, cognitive behavioral therapy (CBT), particularly exposure and cognitive techniques, as well as selective serotonin reuptake inhibitors (SSRIs) and serotonin-norepinephrine reuptake inhibitors (SNRIs) are the most evidence-supported psycho- and pharmacotherapies[71-72]. For depressive disorders, agomelatine (atypical antidepressant) and fluoxetine (SSRI) pharmacotherapies[73], as well as CBT and behavioral activation therapies appear most effective[74]. For alcohol use disorders, naltrexone (opioid receptor antagonist) and acamprosate (GABA analogue) are first-line treatments, with CBT showing mild benefits over minimal treatment[75-77]. While

these treatments are commonly prescribed for anxiety, depressive, and alcohol use disorders, a wide range of other mental health conditions also require similar or alternative therapeutic approaches.

The effectiveness of various therapies differs across populations, including elite athletes, where unique factors may influence psychotherapy outcomes[78]. Diagnosing athletes can be challenging for clinicians, as the physiological effects of intense training can resemble clinical symptoms. Similarly, some rely on superstitious or habit-based behaviors which can be misinterpreted as compulsive tendencies. Beyond diagnostic complexities, several barriers deter athletes from seeking mental health care[79]. Stigma and fear are among the most significant, while personality traits such as hypermasculinity and aggressiveness may further reduce help-seeking behaviors or hinder treatment effectiveness. However, elite athletes often employ problem-focused coping strategies, which may enhance treatment adherence and goal attainment[30]. Moreover, their demanding schedules and potentially unrealistic treatment expectations can make accessing care more challenging than for non-athletes, posing additional difficulties for clinicians[78]. Notably, high quality research on treatment efficacy in athletes remains limited[80]. Among extant studies, CBT-, mindfulness-, and positive psychology-based interventions show promise, yet evidence supporting their effectiveness for common mental health outcomes remains sparse[81-82]. As in general clinical populations, combining psychosocial therapies with pharmacotherapy may be beneficial, but caution is necessary, as medications should not be prescribed indiscriminately given their potential side effects on athletic performance[83].

COVID-19

On the 13th of March, 2020, our ice hockey team embarked on a three-hour bus journey north to Nässjö for a crucial playoff game, fighting for a chance to secure promotion to the next division. Just 20 minutes into the trip, our head coach received a phone call, and just as I grabbed a pre-game meal, the bus abruptly stopped, turned around, and began heading back home. The rest of the season had been cancelled with no plans for rescheduling due to the emerging spread of the Coronavirus disease 2019 (COVID-19).

Figure 3. Image from final playoff game in Höör versus IK Pantern, March 10th, 2020. Photo courtesy of Lola Nilsson.

The proceeding months were marked by unprecedented changes accompanied by feelings of fear, uncertainty, and isolation. Yet, amidst the challenges, there were also moments of calm and togetherness, offering a sense of balance in an otherwise tumultuous time.

While the exact circumstances of the COVID-19 pandemic may never be replicated, it is crucial to reflect on these events and our responses to them. Certain aspects may offer valuable insights and be applicable to future uncontrollable events that involve prolonged periods of significant environmental stress (e.g., wars, environmental disasters, future pandemics).

Definition and epidemiology

In December 2019, reports first emerged from Wuhan, China, describing a rapidly spreading pathogen known as severe acute respiratory syndrome coronavirus 2[84]. Within one month, the virus had reached Sweden, with the first confirmed case identified in Jönköping[85]. The rapid proliferation of SARS-CoV-2 and its subsequent variants catalyzed a global health crisis, coined the COVID-19 pandemic by the WHO on March 11, 2020[84]. New cases continue to be identified daily, though as of May 5th, 2023, it is no longer deemed a global health

emergency[86]. As of February 2025, more than 777 million cases have been reported, resulting in over 7 million deaths worldwide[87].

Origin and symptom presentation

SARS-CoV-2 belongs to the coronavirus family, a group of primarily bat-borne viruses[88]. The virus is highly contagious among humans, particularly in symptomatic individuals, and spreads predominantly through respiratory droplets and aerosols. The clinical spectrum of SARS-CoV-2 infection is heterogeneous, ranging from asymptomatic or mild presentations to severe respiratory failure and mortality. During the acute phase of infection, the most frequently reported symptoms include fatigue, cough, sore throat, anosmia/dysgeusia, fever/chills, and headache[89]. While the majority of cases are mild, a critical subset of patients develops acute respiratory distress syndrome, marked by hypoxemia, lung injury, and hyperinflammation[90]. Other extrapulmonary conditions have also been reported, including gastrointestinal disturbances, acute cardiac, renal, and hepatic injuries, as well as complications such as cardiac arrhythmias, rhabdomyolysis, coagulopathy, and shock. Those particularly at-risk for severe COVID-19 disease and death were, elderly, male, and/or severely obese[91].

A subset of individuals infected with COVID-19 develop persistent symptoms—a condition commonly referred to as post-COVID-19 syndrome or long COVID[92]. The true prevalence of this condition remains elusive due to the dearth of a consensus definition, though estimates indicate that approximately 3–8% of individuals experience symptoms extending beyond four weeks[89,92]. Predominant symptoms include lingering cough, fatigue, loss or alteration of smell and taste, and chest pain or tightness[89]. Risk factors associated with the development of long COVID include female sex, a more severe acute infection, pre-existing medical conditions, older age, high body mass index, and smoking, while vaccination appears to confer a protective effect[92,93-94]. The underlying pathogenesis is hypothesized to involve three distinct mechanisms: (1) a continued viral infection, (2) a disturbed immune response, and (3) inflammation of the endothelium[92]. While vaccination appears to offer protection against the development of long COVID, it has not been proven effective in treating it[93]. The Korean Society of Infectious Diseases has published a set of clinical guidelines and recommendations for managing long COVID, though these have faced criticism[95].

Pandemic spread and governmental response

In wake of its spread in spring 2020, governments worldwide implemented a range of policies to mitigate and suppress transmission. Common measures included border restrictions, school closures, provision of health resources (e.g., masks), limits on mass gatherings, quarantine or lockdown orders, and restrictions on non-essential businesses, among others[96-97]. These interventions aimed both to slow

transmission—"flattening the curve"—and to reduce overall case numbers. In contrast to many countries, Sweden's approach relied primarily on voluntary "soft" measures[98]. Initially, it was thought that implementing such measures could result in natural herd-immunity[99], though later reports of reinfection after natural infection and vaccination ultimately dispelled this possibility[100]. Nevertheless, the Swedish response has been both hailed and harshly criticized by media members and researchers alike[96,98,101-102].

The spread of COVID-19 throughout Sweden varied by region, with large cities being the first to experience significant outbreaks (Figure 4). However, all regions, regardless of size, eventually reported cases, illustrating the widespread impact of the pandemic.

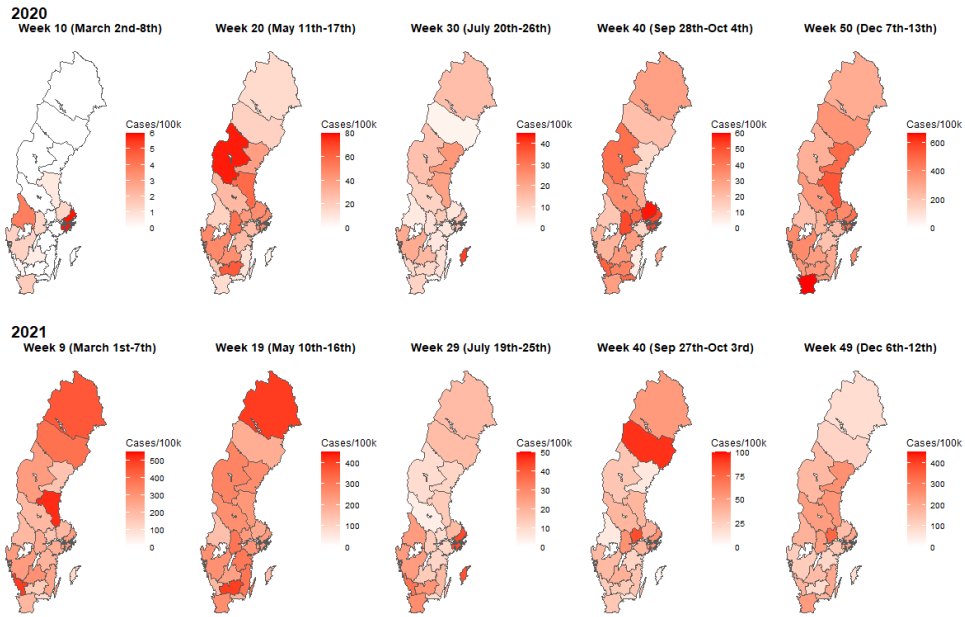

Figure 4. Confirmed cases by region in 10-week intervals 2020-2021.
Data publicly available through the Swedish Ministry of Health[103]

The first confirmed case of COVID-19 in Sweden was reported on January 31, 2020, followed by a second case on February 26, 2020[104]. The first COVID-19-related death occurred on March 11, 2020. Between March 11th and 19th, 2020, in response to escalating concerns over the spread of COVID-19, the Swedish government implemented a series of public health recommendations and restrictions aimed at mitigating transmission. These measures included advising individuals to avoid non-essential visits to healthcare facilities and elderly care homes, maintain social

distancing, work remotely when possible, and stay home if symptomatic. Additionally, the government mandated the prohibition of gatherings exceeding 500 participants, encompassing events such as concerts and sporting competitions. Further guidance emphasized the importance of regular hand hygiene, minimizing contact with elderly individuals, transitioning to distance learning, and refraining from unnecessary travel. Later in March, gatherings of 50 or more people and visiting individuals in elderly homes were prohibited. On June 4th, 2020, testing for COVID-19 became free for symptomatic individuals. On July 1st, 2020, in tandem with reduced spread, various recommendations and mandates were relaxed on travel and restaurants, and on October 1st, 2020, visits to elderly homes were reinstated as cases remained low. However, the onset of the second wave prompted the tightening of restrictions between October and December, 2020. On December 27th, 2020, the first vaccinations were administered in Sweden and by June, 2021, approximately one-third of Swedish adults had received two doses of one of the available vaccines[105]. Recommendations to wear masks on public transport took effect on January 7th, 2021[104].

During the first wave of the COVID-19 pandemic in Sweden, mortality and daily case counts reached their respective peaks in week 15 and week 26 of 2020, with week 15 recording the highest mortality rate observed throughout the pandemic[103]. The emergence of the Alpha and Delta variants ushered in a second wave during autumn 2020 and spring 2021[104]. This wave saw its peak in daily case numbers during week 51 of 2020, while mortality reached its highest point in week 53. The arrival of the Omicron variant in late 2021 marked the beginning of a third wave, characterized by unprecedented levels of transmission. Cases during this wave peaked in week 4 of 2022, recording the highest daily case counts of the entire pandemic, while mortality peaked slightly later, in week 7 of 2022. Confirmed COVID-19 cases and deaths per 100,000 inhabitants as well as key events provided by the Swedish Ministry of Health[103-104] are presented in Figure 5.

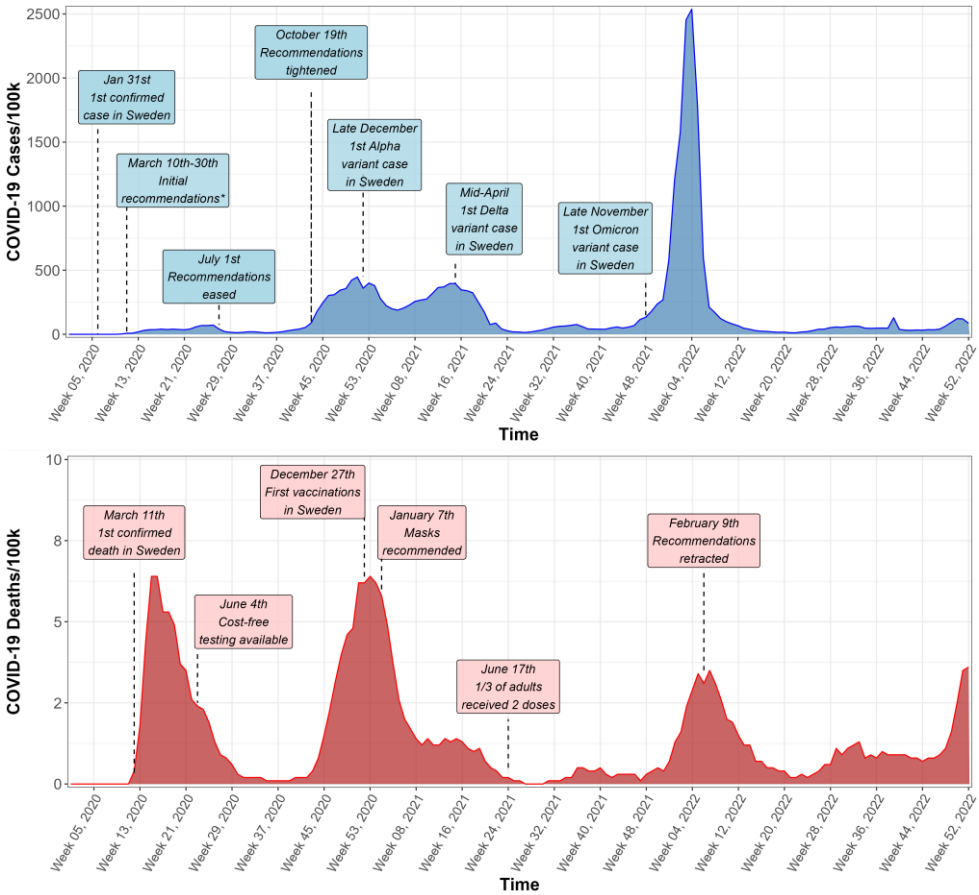

Figure 5. Confirmed COVID-19 cases and deaths with key events in Sweden.
Data publicly available through the Swedish Ministry of Health[103-104]

Impact on sports

Despite the Swedish government's restrained approach to the pandemic as a whole, its policies exerted considerable influence on the physical activity and sporting landscape among the general population and athletes alike[106]. Recommendations and mandates evolved as the pandemic progressed, largely mirroring the relative spread of the virus and related mortality. Predominantly, policy aimed to preserve normalcy—keeping gyms operational and sports activities ongoing—to sustain physical engagement, though more targeted restrictions and recommendations were put into place at various points[107]. For instance, during the first wave of COVID-19, authorities issued recommendations on April 1, 2020, advocating for the cancellation or postponement of competitions and encouraging outdoor training sessions whenever possible. These measures were temporarily relaxed before being

reinstated with greater stringency during the subsequent wave in February, 2021[103,108]. The recurring waves of COVID-19 from autumn 2020 through spring 2021 had a significant impact on sports at all levels. For example, during autumn 2020, reports of COVID-19 outbreaks among team sport athletes, particularly in ice hockey and soccer, began to surface. These outbreaks ultimately resulted in accommodations (e.g., playing behind closed doors), postponements, and cancellations for all levels of play[103,108]. Sports clubs and federations at all levels faced severe economic challenges and required substantial support to survive, with approximately three of five clubs reporting worsened financial situations[108]. In 2021, the economic losses to Swedish sports organizations were estimated at 1-1.5 billion SEK per quarter[108].

Measures taken by the rest of the world also had a significant impact on Swedish athletes and sports staff, largely via the postponement and cancellation of major sporting events. For instance, after much deliberation, the 2020 Tokyo Summer Olympic and Paralympic Games were postponed to 2021 and eventually held without public spectators. Preparations and qualifications ahead of the Olympics became especially challenging for athletes, sports staff, and organizers in early 2020 due to restrictions and postponements, with team sports being particularly afflicted[108]. Other competitions involving Swedish elite athletes were also cancelled. For example, world championships in cross-country skiing, alpine skiing, archery, biathlon, curling, figure skating, and ice hockey were cancelled. Domestically, ice hockey championships were curtailed and soccer competitions postponed. Moreover, several major tournaments, including the European Football Championships, were deferred to the following year. In some cases, events were held in controlled environments or behind closed doors, as seen with the National Basketball Association and National Hockey League championships in the United States, as well as the European Football Champions League finals.

Mental health impact on athletes

The pandemic and its profound disruptions to daily life likely served as a unique and unprecedented stressor for much of the population, raising concerns that, without timely intervention, it could give rise to adverse mental health outcomes and behavioral addictions[110-111]. Recent studies deploying prospective study designs as well as meta-analytical reviews highlight that the COVID-19 pandemic may have had initial deleterious effects on the general population's mental health, but later rebounded by mid-2021[112-114]. One subgroup of particular interest was elite athletes, a group often thought to be impervious to mental health struggles[115]. Researchers argued that restrictions limiting training and competition leading to the cancellation of competitions could have severe economic, physical, and psychological consequences (e.g., financial instability, detraining, premature retirement), while fostering uncertainty about athletes' sporting careers[116-118]. On the other hand, worry

and fear of contracting COVID-19, coupled with concerns over its potential to compromise endurance and performance[119-120], was also seen as a threat and potential precursor to poor outcomes. It was believed that this combination of factors could create a conducive environment for the proliferation of adverse mental health symptoms among elite athletes[112-114].

Early studies among athletes indicated a deterioration in mental health during the pandemic, with female sex and elite level of play identified as risk factors[121]. Psychological distress and career uncertainty were particularly pronounced in response to competition postponements, such as the delayed Olympic Games[116]. However, when the Tokyo Olympics finally commenced, the 24-hour mental health services provided to participants showed utilization rates consistent with those observed at previous Olympic Games[122-123]. This stability suggests that the heightened psychological distress may not have translated into clinical-level concerns or a notable increase in help-seeking behavior. Similarly, despite the widespread introduction of telehealth psychiatric services for all to accommodate anticipated demand under social distancing measures, their utilization remained modest[124]. Together, these findings highlight a disconnect between elevated symptom prevalence and actual help-seeking behavior during the pandemic.

Another subgroup of elite athletes—high school student-athletes—drew significant attention due to the substantial impact of pandemic-related restrictions. These included the transition to distance learning and the postponement, restriction, or cancellation of training and competitions, all of which profoundly disrupted their daily routines. How these disruptions, as well as the eventual lifting of restrictions in Sweden, influenced the mental health and future aspirations of this group of elite-level student-athletes is explored in Study I.

Traumatic brain injury and sports-related concussion

When I was young, one of my favorite athletes was Paul Kariya, a Canadian ice hockey player and captain for the Mighty Ducks of Anaheim (seen in Figure 6). Kariya was renowned for his exceptional stickhandling and playmaking abilities, consistently ranking among the top point scorers in the National Hockey League. Standing at 178 cm, he was neither the tallest nor the strongest player on the ice, but what he lacked in size, he made up for skill and toughness.

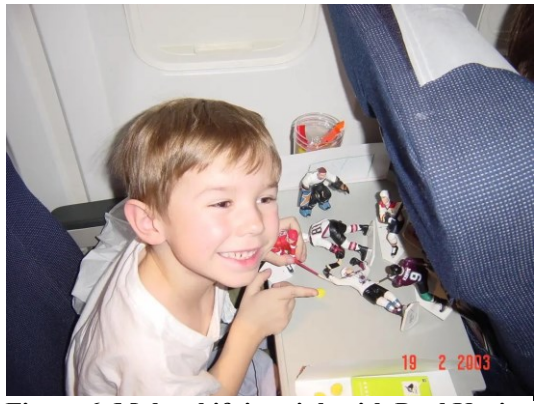

Figure 6. Make-shift ice-rink with Paul Kariya on flight to Sweden. February 19th, 2003

Kariya's toughness was on full display during the 2003 Stanley Cup Finals, when the Mighty Ducks faced off against the New Jersey Devils. In the second period of Game 6, Kariya made a routine pass to a teammate entering the offensive zone, unaware that a Devils defenseman had locked him in his sights. Just seconds after releasing the puck, Kariya was blindsided by a devastating blow to the head. He collapsed to the ice, motionless and unconscious. Forty-eight seconds later, he awoke and attempted to stand up. Unable to do so, he needed a pair of teammates to carry him off the ice to the dressing room. His night was officially over… or so we thought.

To the amazement of fans and commentators alike, Kariya returned to the bench to play just minutes later. Less than 12 minutes from the moment he laid unconscious, Kariya received the puck on the wing, entered the offensive zone, and blasted a slapshot into the top corner of the net. The moment was immortalized by play-by-play announcer Gary Thorne's call: "Off the floor, on the board!" The Ducks went on to win, forcing a decisive Game 7. Although the Ducks ultimately lost the series, Kariya's return became a symbol of grit and heroism in professional hockey.

Years later in an interview with TSN[125], Kariya revealed he had no recollection of the hit, his return, or even the goal. Neither could he recall anything leading up to Game 6 or the subsequent Game 7. Kariya had suffered a concussion — not his first, nor his last. Persistent symptoms from repeated concussions would ultimately force him into early retirement from his professional ice hockey career[126].

Stories like Kariya's are common in sports, where playing through injury is often glorified by fans, teammates, and coaches alike. While these moments can be celebrated as displays of bravery, they raise critical questions about the long-term

health risks associated with playing through concussions and the culture of toughness ingrained in sports. The growing awareness of concussion-related consequences has prompted ongoing discussions about the rules, safety protocols, and cultural norms surrounding injury management in sports.

Definition and classification

Menon and colleagues[127] define Traumatic brain injury (TBI) as an "alteration in brain function, or other evidence of brain pathology, caused by an external force" (pp. 1637). Severity is presented on a spectrum, but largely classified into mild, moderate, and severe cases, of which approximately 90% are classified as mild. Although many classification methods exist, clinics largely rely upon the duration of unconsciousness (LOC), ratings on the Glasgow Coma Scale (GCS), and the duration of post-traumatic amnesia (PTA) to assess TBI severity (Table 2)[128].

Table 2. Traumatic brain injury classification system

TBI classification	LOC duration	GCS score	PTA duration
Mild	<30 minutes	13-15	<24 hours
Moderate	30 minutes-24 hours	9-12	1-7 days
Severe	>24 hours	3-8	>7 days

Note. TBI = traumatic brain injury, LOC = loss of consciousness, GCS = Glascow Coma Scale, PTA = post-traumatic amnesia.

These criteria, in addition to others, are also incorporated into the American Congress of Rehabilitation Medicine's (ACRM) definition and diagnostic criteria for TBI[129]. First, the injury must result from the transfer of mechanical energy to the brain via an external force (Criterion 1). Second, it must produce at least one clinical sign indicative of disrupted physiological function (Criterion 2; e.g., LOC, alteration in mental status, partial or complete PTA). Third, the injury must be accompanied by at least two acute physical, cognitive, or emotional symptoms within 72 hours of the incident, signaling impairment of brain function (Criterion 3; e.g., confusion, headache, "mental fog", irritability). Finally, the presence of either laboratory findings related to cognitive, balance, or oculomotor impairment or elevated blood biomarkers indicative of intracranial injury, or neuroimaging evidence of brain injury, is required (Criteria 4 and 5). A TBI diagnosis should only be made if the injury meets the specified criteria. Furthermore, the injury can be classified as mild (mTBI) if individuals experience less than 30 minutes of LOC, a GCS score of 13-15, and less than 24 hours of PTA (Table 1)[129]. Notably, conventional neuroimaging techniques (e.g., computer tomography, magnetic resonance imaging) do not reveal

intracranial abnormalities after mTBI, though more advanced techniques used in research settings can discern micro-changes in structure and function[130].

The English term “concussion” derived from the Latin words *concutere*, meaning "to shake violently", and *concussus*, meaning "the act of striking together"[131] is and, according to the ACRM, can be used interchangeably with mTBI[129]. However, definitions of concussion are not equivalent across all governing bodies. Another international organization, the Concussion in Sport Group (CISG), dissents by offering a slightly modified definition of sports-related concussion (SRC), an mTBI sustained during sports-related activity, which adopts more liberal diagnostic criteria[132]. For example, the CISG criteria for SRC do not require clinical signs to be present at the time of initial examination. The ACRM provides additional criteria for a “suspected mTBI”, but according to these criteria, an athlete would be diagnosed with an SRC according to the CISG definition[132]. The various subtypes of TBI and how they are interrelated are illustrated in Figure 7.

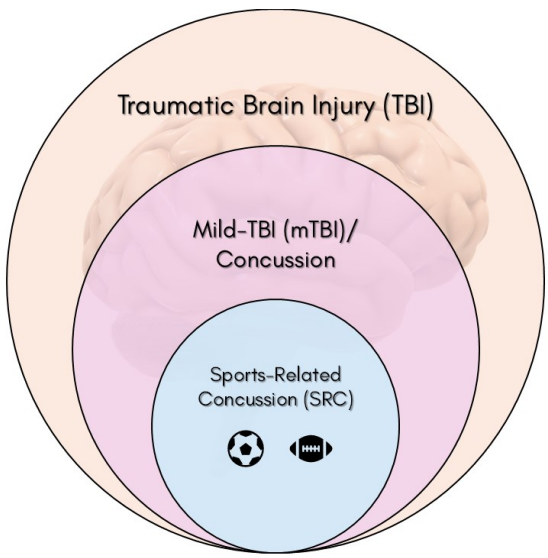

Figure 7. Traumatic brain injury and its subcategories

Epidemiology

TBI is among the leading causes of mortality and disability worldwide[133], with falls, traffic accidents, and sports injuries being among the most common causes of TBIs[134]. One in five adults are estimated to have experienced at least one TBI with LOC during their lifetime[135]. The incidence of both mTBI and SRC has increased over time, likely due to heightened awareness, evolving diagnostic criteria, and

improved surveillance and detection methods[136-137]. Many epidemiological studies rely on registry data that primarily include diagnosed concussion cases. In sports settings, however, athletes often conceal or fail to report symptoms due to various psychosocial reasons[138], leading to a potential underestimation of the true prevalence and incidence within the population. Nevertheless, contact, collision, and combat sports (e.g., American football, boxing, ice hockey, rugby, rugby union) as well as equestrian sports appear to have the highest incidence rates[139-142].

Biomechanism of injury

SRC-induced linear and rotational forces exerted on the brain can result in coup and contrecoup focal injuries through direct collisions between the dura and cranium, simultaneously stretching and contorting cortical tissues to the point of axonal and vascular shearing[143]. The primary injury triggers a neurometabolic cascade, initiating a sequence of pathological events, including ionic flux and excitotoxicity, an ensuing energy crisis, cytoskeletal damage, disrupted neurotransmission and microvascular function, demyelination, stunted neurogenesis, prolonged inflammation, and ultimately, apoptosis[143-144]. Although TBIs impact the brain as a whole, some areas and systems are more vulnerable than others[143-144], namely the brain's white matter tracts (e.g., corpus callosum, internal capsule, fornix), vasculature system, and medial gray matter structures (e.g., hippocampus, amygdala, cingulate gyrus, cerebellum).

Acute pathophysiology

At the moment of impact, a complex cascade of intra- and extracellular processes is triggered, occurring simultaneously and unfolding over various timeframes—ranging from seconds and minutes to hours, days, months, and even years post-injury. First, the physical tension exerted on the cytoskeleton can compromise the structural integrity of a neuron's axon. This may result in abrupt axonal disconnection and swelling (i.e., beading)[145]. Myelinated axons are more resilient to diffuse axonal injury[146], though widespread demyelination of white matter tracts may still occur[147].

Meanwhile, a rapid ionic imbalance ensues[144]: potassium ions exit the neuron while sodium and calcium ions enter, precipitating broad neuronal depression. This disturbance compromises the integrity of cellular barriers, hinders the clearance of extracellular matter, prolongs inflammatory processes, and inhibits the repair of neuronal networks. In an effort to re-establish homeostasis, the neuron expands the use of its membrane ionic pumps, an energy and glucose-demanding process that catalyzes depolarization and glutamate release. However, concurrent disruptions to the microvasculature elicits a drop in cerebral blood flow, which in turn inhibits oxygen from being delivered to these cells (i.e., ischemia), further accelerating the expenditure of the cell's energy resources and restricting inflammation[148].

The elevated efflux of potassium and the accelerated release of glutamate typically return to baseline levels within hours following the insult, whereas the accelerated influx of calcium generally normalizes within 3 to 4 days[144]. Glucose metabolism initially increases during the first hours before declining and remaining suppressed for approximately one week, while cerebral blood flow remains reduced throughout this period. In the meantime, a complex inflammatory response takes place, largely driven by the upregulation of pro- and anti-inflammatory cytokine production and their modulation of the immune system. This initial response, as in other disease models, may be beneficial, but can lead to poor prognosis if prolonged. Poor prognosis has also been associated with the elevation of various cytokines, namely Interleukin-1 (IL-1), IL-6, IL-8, Tumor necrosis factor alpha, and IL-10[149]. The progression of these processes over time following the initial impact is referred to as secondary brain injury and can lead to the vastly heterogeneous, sometimes erratic, clinical presentations seen across all severities of TBI. Additionally, this period represents a window of vulnerability, during which continued physical exertion or additional head trauma can exacerbate the injury and prolong recovery[150].

Sports-related concussion detection and evaluation

Within the realm of sports, various strategies are employed to detect SRCs, many of which are outlined in the latest version of the Sports Concussion Assessment Tool (SCAT6)[151]. During athletic competition, if an athlete experiences a significant impact to the head or body, an observer can utilize SCAT6 to determine whether the athlete should be temporarily removed from play for further evaluation.

Observers must first assess whether the athlete exhibits any overt “red flags” that necessitate immediate removal and medical intervention. These red flags may indicate a more severe brain or spinal injury requiring urgent medical attention (Table 3). If no red flags are present, the athlete undergoes a series of immediate on-site assessments. These include an evaluation of observable signs (Table 3), GCS scoring, cervical spine assessment, coordination and oculomotor screening, and memory testing. If the athlete fails any of these initial screenings, they are immediately removed from the field of play and provided medical care. Otherwise, they are taken off the field for further assessment. Additional evaluations include a comprehensive symptom checklist (Table 3), cognitive screening, coordination and balance tests, and an in-depth memory assessment. The examiner then makes a clinical decision based on the athlete’s performance, their baseline data (if available), and clinical judgment. Those responsible for conducting these assessments often work under time constraints; however, efforts are being made to allow for more thorough evaluations without undue pressure—for example, the introduction of concussion substitutions in soccer.

Table 3. "Red flags", observable signs, and symptom evaluation list

"Red flags"	Observable signs	Symptom evaluation
• Neck pain or tenderness • Seizure or convulsion • Double vision • LOC • Weakness or tingling/burning in more than 1 arm or in the legs • Deteriorating conscious state • Vomiting • Severe or increasing headache • Increasingly restless, agitated or combative • GCS <15 • Visible deformity of the skull	• Lying motionless on playing surface • Falling unprotected to the surface • Balance/gait difficulties, motor • Incoordination, ataxia: stumbling, slow/labored movements • Disorientation or confusion, staring or limited responsiveness, or an inability to respond appropriately to questions • Blank or vacant look • Facial injury after head trauma • Impact seizure • High-risk mechanism of injury (sport-dependent)	• Headaches • Pressure in head • Neck pain • Nausea or vomiting • Dizziness • Blurred vision • Balance problems • Sensitivity to light • Sensitivity to noise • Feeling slowed down • Feeling like "in a fog" • "Don't feel right" • Difficulty concentrating • Difficulty remembering • Fatigue or low energy • Confusion • Drowsiness • More emotional • Irritability • Sadness • Nervous or anxious • Trouble falling asleep

Note. Direct quotes from SCAT6 by Echemendia et al., 2023 (pp. 624-625)[151]. "Red flags" and observable signs assessment competed immediately. Symptom evaluation performed off-field. SCAT6 = Sport Concussion Assessment Tool (6th edition). LOC = loss of consciousness, GCS = Glascow Coma Scale.

Advancements in diagnostics and monitorization

An area of growing interest in the SRC field is the use of biomarkers and neuroimaging techniques to enhance diagnostic accuracy and monitor recovery[130]. Biomarkers, defined as measurable biological substances that reflect underlying physiological or pathological processes, have strong theoretical and practical promise[152]. Notable biomarkers associated with SRC and recovery include glial fibrillary acidic protein (GFAP), neurofilament light (NfL), tubulin-associated unit protein (tau), and S100B[152]. GFAP, a marker of astrogliosis, reflects the accumulation of astrocytes near damaged neurons during attempts at cellular repair. NfL, a neuronal cytoskeletal protein, serves as a key indicator of axonal injury. Similarly, tau, a microtubule-associated protein essential for maintaining axonal structural integrity, has been implicated in axonal injury and degeneration[153]. Finally, S100B, a protein predominantly expressed in astrocytes, is released into the

bloodstream following intracranial lesions or blood-brain barrier disruption[152]. Studies employing these biomarkers offer valuable insights into the underlying pathophysiological and inflammatory processes both during the acute phase and throughout the subsequent recovery period.

Advancements in neuroimaging techniques offer significant promise for improving the detection of abnormalities associated with SRC. While conventional imaging methods, such as structural, functional, and diffusion-weighted magnetic resonance imaging, typically reveal no gross changes following SRC, emerging technologies like ultra-high-field 7T scanners and more sophisticated imaging sequences and analytical techniques may enhance the detection of subtle structural and functional abnormalities[154]. Similarly, the application of biomarkers and neuroimaging in SRC detection and recovery continues to progress; however, their integration into routine clinical practice remains limited, largely due to insufficient evidence and logistical challenges. As ongoing advancements improve the feasibility, accessibility, and diagnostic accuracy of biomarker testing and advanced neuroimaging, these tools hold the potential to transform SRC diagnostics and recovery monitoring, bridging the gap between innovative research and widespread clinical implementation[130].

Acute symptom presentation and management

The SCAT6 assesses 22 distinct acute post-concussion symptoms, with headache, dizziness, concentration difficulties, and light sensitivity being the most commonly reported following SRC[155]. These symptoms can be grouped into five overlapping clinical profiles: cognitive/fatigue, migraine, vestibular, ocular, and anxiety/mood[156]. Notably, migraine and anxiety/mood profiles account for 50% of all cases, while the remaining half involve the other three profiles. Most individuals who sustain an SRC recover fully within 14 days and return to sport[157]. However, in cases of prolonged symptoms, targeted symptom-centered therapies—both behavioral and pharmacological—may be employed to facilitate recovery[156].

The latest CISG consensus statement provides updated general guidelines for managing concussion and its symptoms[158]. Immediately following a diagnosis, medical personnel should monitor the individual closely in case of sudden symptom exacerbation. Thereafter, they are advised to undergo a brief period of relative rest (24–48 hours) during which they may perform normal daily activities and light physical exercise (e.g., short walks) while minimizing screen time, provided symptoms do not significantly worsen. After this period, individuals should follow a graded, stepwise recovery program designed for return-to-sport (RTS) and return-to-learn (RTL), as outlined in Table 4.

Table 4. Return-to-sport and Return-to-learn management strategies

Step	Return-to-sport
1	Engage in daily activities that do not worsen symptoms, with a gradual return to work or school.
2	Begin with light aerobic exercise (<55% maximum heart rate). Progress to moderate aerobic exercise (<70% maximum heart rate) and potentially light resistance training.
3	Perform sport-specific drills (e.g., running, directional changes) in a non-team setting that avoid head impact risks.
4*	Progress to higher-intensity, complex drills within a team environment, resuming typical exercise intensity, coordination, and cognitive demands.
5	Participate in normal training sessions to restore confidence and allow coaching staff to assess functional skills.
6	Resume regular competitive play.
Step	**Return-to-learn**
1	Engage in daily activities that do not cause more than a mild exacerbation of symptoms. Begin with brief periods and gradually increase duration, while minimizing screen time.
2	Reintroduce homework, reading, or other cognitive tasks outside the classroom to build mental endurance.
3	Gradually resume school attendance to acclimate to academic demands.
4	Progress to full-day attendance once it can be tolerated without symptom exacerbation

Note. Steps based on Patricios et al. (2023)[158]. *Advancement to higher-level steps should only occur after complete resolution of symptoms, normalization of cognitive function, and absence of any other concussion-related clinical findings—both at rest and following physical exertion.

These updated guidelines contrast sharply with earlier practices, such as "cocoon therapy," which advocated strict rest. Recent evidence suggests that engaging in controlled, symptom-challenging activities facilitates and accelerates recovery, marking a significant shift in concussion management strategies[159].

Chronic symptoms and mental health implications

The biological mechanisms underlying the development of psychiatric symptoms following SRC remain elusive. However, it is hypothesized that SRC may disrupt serotonergic transmission, contributing to psychological sequelae such as depression and anxiety[160]. Although selective serotonin reuptake inhibitors (SSRIs) are commonly used as first-line pharmacological treatments for post-concussion

depressive symptoms, their efficacy appears to be modest compared to their effects in patients with depression unrelated to head injury, which may suggest that distinct neurobiological pathways may underpin post-injury psychiatric symptoms[161].

Nonetheless, the mood/anxiety clinical profile is the second most prevalent among the five concussion clinical profiles, with approximately 24% of individuals experiencing primarily mood- and anxiety-related symptoms (e.g., depression, anxiety, panic) during the acute phase of injury[156]. While most sequalae generally resolve within 14 days[157], some research indicates that up to one in five remain symptomatic beyond 30 days post-injury[162], and one in six beyond three months[163]. The prevalence of newly developed psychiatric disorders within 3–12 months following mTBI is challenging to quantify, but studies estimate that 9–15% of individuals develop depressive disorders and 10–22% develop post-traumatic stress disorder[164]. Research on individuals with persistent post-concussion symptoms reveals a formidable positive correlation between persistent post-concussion symptoms and depression, with the majority of participants endorsing elevated symptoms of depression or anxiety[165].

Furthermore, much research has been aimed at establishing whether sustaining multiple concussions is associated with poor psychiatric outcomes. Extant studies generally show that there is a positive correlation between the cumulative number of SRCs an athlete sustains throughout their career and psychiatric symptom burden[166], particularly depression[167-168]. However, a simple dose-response relationship is not presumed as the relationship between concussion history and psychiatric outcomes is moderated by various pre-injury and post-injury factors, including psychiatric history, biological sex, psychological response to injury, stress levels, physical function and health, diet quality, sleep duration, level of physical activity, and drug use, among others[167,170-172]. Nevertheless, sustaining multiple concussions may prompt considerations of early retirement, a prospect that can be particularly distressing for elite athletes whose livelihoods depend solely on their sporting careers and who may lack alternative future prospects[173]. This transition is further compounded by the threat to athlete identity—a central component of self-concept to which many athletes maintain a profound attachment[174].

Neurodegenerative diseases

Repetitive SRC (rSRC) and its association with various neurodegenerative diseases has been a subject of intense debate. Neurodegeneration is characterized by progressive neuronal destruction and dysfunction, often induced by the accumulation of proteins that impair neuronal activity. Some research suggests that elite athletes with substantial SRC and head trauma history may be at heightened risk of developing various neurodegenerative disorders, such as Alzheimer's disease, amyotrophic lateral sclerosis, and dementia[175-177].

Martland was among the first to describe a form of neurodegeneration following rSRC, evidenced by clinical presentations including psychiatric illness, parkinsonism, and cognitive decline in a series of boxers during the 1920s[178]. He coined this condition, “punch drunk syndrome”. Although several case reports were published in the decades following Martland’s work, it was not until the landmark case study by Omalu and colleagues in 2005[179] that “punch drunk syndrome,” now recognized as chronic traumatic encephalopathy (CTE), gained significant attention both in the world of research as well as in the public eye[180].

CTE Neuropathological Change (CTE-NC) is a post-mortem neuropathological diagnosis characterized by the accumulation of hyper-phosphorylated tau (p-tau) in neurons, with a predilection for cortical sulci and perivascular regions[181]. Two distinct staging systems are commonly used to classify the severity of CTE-NC. The first is a binary system that categorizes cases as either "low CTE" or "high CTE," contingent on the extent of anomalous p-tau aggregates. Low CTE is defined by fewer than five brain regions affected, whereas high CTE involves five or more affected regions. The second system uses a four-stage classification (Stages 1–4) to describe the progressive proliferation of p-tau pathology, beginning with isolated lesions in the frontal and temporal sulci (Stage 1), advancing to medial temporal lobe involvement (Stage 2), hippocampal accumulation (Stage 3), and culminating in widespread pathology with neuronal loss, gliosis, and astrocytic tau (Stage 4).

The diagnostic criteria for the clinical syndrome associated with CTE-NC, known as traumatic encephalopathy syndrome (TES), were recently revised by Katz and colleagues[182]. According to these updated criteria, a diagnosis of TES requires the presence of three key components: (1) substantial exposure to repetitive head impacts over an extended period, (2) progressively worsening cognitive impairments (e.g., deficits in episodic memory or executive functioning) and neurobehavioral disturbances (e.g., impulsivity, emotional instability), and (3) deficits that cannot be explained by other medical, neurological, or psychiatric conditions. Despite these updates, both the clinical and neuropathological diagnostic criteria for TES remain highly controversial. For example, applying these criteria to general population samples indicates unrealistically high prevalence of TES, especially among those with chronic pain and those who had experienced past year suicidality[183]. Future research aims to clarify whether CTE-NC-related neuropathology is a causal factor in neuropsychiatric symptoms, how this pathology differs from other neurodegenerative diseases such as Alzheimer’s disease, and whether the condition is inevitably progressive[158].

Aims

General aims

Some research suggests that athletes experience adverse mental health symptoms at rates comparable to the general population. However, those engaged in elite sports are exposed to a range of stressors unique to this high-performance context, in addition to stressors encountered by the general population, to which they may respond differently or with heightened vulnerability. The first aim of this thesis was to investigate the prevalence of common adverse mental health symptoms across various athlete populations. The second aim was to explore associated risk factors, with a particular focus on both environmental stressors, such as the COVID-19 pandemic, and biological stressors, such as SRC. Lastly, athletes and sports staff may perceive distinct facilitators and barriers to help-seeking, alongside unique challenges in navigating the mental healthcare system. Therefore, the final aim was to examine their experiences of seeking and receiving psychiatric care at a mental health clinic specialized in elite sport.

Study-specific aims

Study I

The primary aim of this study was to assess changes in the prevalence of depressive and anxiety symptom burden among elite high school student-athletes in Sweden during the COVID-19 pandemic (February 2021) compared to after the lifting of restrictions (February 2022). The secondary aim was to identify personal and sports-related factors associated with endorsing clinically relevant symptoms of depression or anxiety following the removal of pandemic-related restrictions.

Study II

In this study, we first aimed to determine the prevalence of various elevated mental health symptoms (depression, anxiety, alcohol consumption, burnout, problematic social media use) among elite ice hockey players and compare these rates to those observed in the general population and other athlete samples. Secondly, we aimed to investigate the association between the burden of mental health symptoms and the number of concussions sustained across players' athletic careers.

Study III

In this study, we aimed to determine the prevalence of problem gambling in elite ice hockey athletes — a relatively rare condition, but one that may be overrepresented in this populations for various psychosocial reasons. Furthermore, we aimed to explore how problem gambling symptom burden correlated with personal and sport-related factors, as well as its association with other adverse mental health outcomes, such as depression, anxiety, and hazardous alcohol consumption.

Study IV

In this study, we aimed to explore how adverse mental health symptoms develop and manifest in elite athletes and sports staff, as well as how they perceive the process of seeking and receiving care. Additionally, we aimed to evaluate the quality of care they received at a sports-specific mental health clinic.

Materials and methods

The present thesis comprises four studies based on three unique samples, with strong representation of both male and female athletes and staff across multiple sports. The large sample of elite high school student-athletes in Study I was hypothesized to be particularly vulnerable to adverse mental health outcomes due to the COVID-19 pandemic, as restrictions implemented to curb the spread of the virus disrupted training and competition opportunities at various stages — potentially creating an environment conducive to poor mental health. The large sample of elite ice hockey players analyzed in Studies II and III was hypothesized to have a high prevalence of SRCs and an elevated risk of problem gambling compared to athletes in other sports and the general population, potentially identifying cultural differences in ice-hockey. Lastly, the treatment-seeking and interviewed sample in Study IV included athletes and sports staff with diverse diagnoses, ages, sports backgrounds, help-seeking trajectories, and experiences of care at a sports-specific mental health clinic. This diversity enables a more comprehensive understanding of these individuals' mental health and help-seeking experiences, while offering insights into how personal and sport-related factors may shape these experiences. I used R to conduct all statistical analyses and generate figures, NVivo to conduct qualitative analyses, and Microsoft PowerPoint to generate infographics. For the sake of brevity, statistical tests previously reported in published work are not reiterated unless additional analyses or effect measures were added. In such cases, only the new effect measure and its corresponding *p*-value are presented. All other statistical results included in the text reflect newly conducted analyses. Table 1 provides a summary of the designs, samples, and analyses deployed across studies.

Table 5. Study characteristics

Characteristic	Study I	Study II	Study III	Study IV
Design	Repeated cross-sectional survey	Cross-sectional survey	Cross-sectional survey	Retrospective medical record review, qualitative phenomenological
Study period	2021-2022	2022-2024	2022-2024	2024-2025
Sample	High-school student-athletes enrolled in nationally recognized elite sports programs offered in tandem with high-school curriculum (RIG/NIU)	Elite ice-hockey athletes competing in the SHL, HA, or SWHL	Elite ice-hockey athletes competing in the SHL, HA, or SWHL	Elite athletes and staff who have sought care at the Malmö psychiatric outpatient clinic for elite sport and health
N	13,249	648	628	Quantitative: 96 Qualitative: 15
Published analytical methods	Student's-*t*, Mann-Whitney *U*, Chi-square, logistic regression	Analysis of variance, Kruskal-Wallis, Dunn, Chi-square, Fisher exact, logistic regression	Student's-*t,* Chi-square, Fisher exact, count regression, ordinal regression	Student's *t,* semi-structured interviews, thematic analysis

Note. SHL = Swedish Hockey League, HA = HockeyAllsvenskan, SWHL = Swedish Women's Hockey League

Study I

Setting and participants

This study was conducted in collaboration with the Swedish Sports Confederation, which administers an annual online, anonymous survey to all student-athletes enrolled in national elites-sport programs (Swedish: *riksidrottsgymnasium*; RIG) and regional/local elites-sport programs (Swedish: *nationellt godkända idrottsutbildningar;* NIU) across the country each February. RIG represents the highest tier of the Swedish sports system, with approximately 1,200 student-athletes enrolled at any given time. In contrast, NIU programs, which are considered second-tier, serve a larger pool of around 10,000 student-athletes. Adolescents entering high school can apply to either system through a national application process for RIG programs or regional application systems for NIU programs.

Design and procedure

To answer our research questions, we added additional questions pertaining to the COVID-19 pandemic in 2021 and 2022 surveys. The survey battery consisted of demographic questions pertaining to sex, type of sport, and school year, as well as validated measures of depression and anxiety. Symptoms of depression and anxiety were measured using the Patient Health Questionnaire (PHQ)[185] and the Generalized Anxiety Disorder questionnaire (GAD)[186], respectively. In 2021, the PHQ-9 and GAD-7 were administered, while the PHQ-2[187] and GAD-2[188] versions were given in 2022. As the items included in the PHQ-2 and GAD-2 consist of items from the full-versions, we were able to take the corresponding items from the PHQ-9 and GAD-7 administered in 2021 to make prevalence rates directly comparable across years. We also included additional questions surrounding concerns over their sporting careers and changes in mental health due to the COVID-19 pandemic. In total, 7021 and 6228 participants completed more than 50% of items and were included in analyses from 2021 and 2022, respectively. As the survey was anonymous, data were not paired. Ethical approval was sought from the Swedish Ethical Review Authority, but the board deemed approval unnecessary as the study did not involve personally identifiable information (Dnr. 2020-07246).

Statistical analysis

Based on extant research at that time and the distinct differences between the two time points, we hypothesized that the overall depression and anxiety symptom burden as well as the prevalence of clinically significant symptoms would decrease from 2021 to 2022. We also hypothesized that those who perceived a greater negative effect on their mental health by the pandemic, those that were more worried over their sporting career, females, and those in winter sports would be more likely to screen positively for clinically significant levels of depression and anxiety. To test these hypotheses, we deployed Student's-*t* test to measure changes in symptom burden, Mann-Whitney *U* tests to measure changes in mental health change and career worry due to COVID-19, Chi-square tests to compare prevalence rates of clinically significant symptoms, and logistic regression to assess factors associated with positive screens.

As the oldest article included in this thesis, I revisited and reanalyzed this dataset using statistical techniques acquired during my studies. This reanalysis involved implementing ordinal and count regression models where appropriate, along with generalized linear mixed models to account for clustered data. Additionally, I provided alternative effect measures, including risk differences for binary outcomes and probability indices for Mann-Whitney *U* tests, to better convey the magnitude of observed effects. I also adjusted the reference groups in multiple logistic regression models to enhance the interpretability of the results and conducted post-hoc analyses to investigate whether the observed change in prevalence was driven by sex or sport.

Study II/III

Setting and participants

These studies were conducted in close collaboration with the Swedish Ice Hockey Players' Association (Swedish: *Sveriges ishockeyspelares centralorganisation*, SICO). Our research group has a long-standing collaborative relationship with SICO, having previously worked together to administer surveys during the COVID-19 pandemic for earlier projects. The union represents players in the male Swedish Hockey League (SHL) and HockeyAllsvenskan (HA), as well as the female Swedish Women's Hockey League (SWHL). SICO advocates for players' athletic, economic, social, and union interests in negotiations with employers, clubs, leagues, and the Swedish Ice Hockey Association. Each competitive season, the union aims to visit each club at least once to converse with the players and provide information and guidance.

The SHL is the top-tier men's ice hockey league in Sweden, comprising 14 teams across the country. The league features a regular season followed by playoffs, where the top 10 teams compete for the championship title. The bottom two teams face relegation play-offs against the top team from the second division (HA). During the 2022–2023 season, 472 players (73.4% Swedish) were listed on SHL rosters at any point, with the average age ranging from 23.7 to 27.3 years across teams[189]. This includes players who never made an appearance, those on loan, and regular starters. The average annual salary for SHL players during the 2024–2025 season was 765,110 SEK (~$71,135 USD)[190].

The HA serves as the second division of elite men's ice hockey in Sweden, also comprising 14 teams. The league follows the same regular season and playoff structure as the SHL, with the crowned champion earning the chance for promotion through play-offs against the SHL's bottom two teams. In the 2022–2023 season, 549 players (77.8% Swedish) were officially rostered, with an average age ranging between 22.4 and 25.5 years across teams[191]. While average salaries are not publicly available, most players are able to financially support themselves through hockey alone[192].

The SWHL is the highest division of women's ice hockey in Sweden, consisting of 10 teams. Following the regular season, the top 8 teams enter playoffs to compete for the championship, while the bottom two teams face relegation play-offs against the winner of the second division. In the 2023–2024 season, 279 players (59.0% Swedish) were listed on team rosters, with average ages ranging from 20.3 to 23.9 years across teams[193]. Although average salaries are not available, the majority of SWHL players are unable to financially sustain themselves through hockey alone, with only one-third of players identifying hockey as their primary occupation[192].

Design and procedure

In this population of elite ice-hockey players, we investigated the prevalence of various adverse mental health symptoms (depression, anxiety, hazardous alcohol consumption, problematic social media use, burnout, and problem gambling), intercorrelations, and demographic and sports-related factors (e.g., SRC history) associated with elevated symptom burden. Based upon previous research indicating no relationship with SRC and elevated prevalence among elite athletes, gambling outcomes became the main subject of its own paper (Study III), while other outcomes would be under study in Study II. The survey battery comprised items assessing demographics (e.g., age, sex), psychiatric history, SRC history, and adverse mental health symptom burden.

We assessed psychiatric history with items querying previous diagnoses of learning disabilities, depression, panic disorder, social phobia, attention deficit disorder, attention deficit hyperactivity disorder, chronic fatigue, obsessive-compulsive disorder, gambling addiction, and substance use disorder. We assessed SRC history with four items measuring the frequency of experiencing: (1) balance difficulties or fogged vision without LOC or PTA, (2) PTA without LOC, (3) LOC lasting < 30 seconds, and (4) LOC lasting ≥ 30 seconds after a collision. Items were rated on a scale ranging from never to four or more occasions. Adverse mental health symptom burden was measured using a range of validated instruments (see Table 6 for specific items and cut-offs used). If an individual met a clinical cut-off for any of the measures, they were notified of this at the end of the survey and provided contact information to the psychiatric outpatient clinics for elite athlete and health located in Stockholm and Malmö.

- Depression: Patient Health Questionnaire (PHQ-9), based on DSM-IV criteria of major depressive disorder[185].
- Anxiety: Generalized Anxiety Disorder questionnaire (GAD-7), based on DSM-IV criteria of GAD[186].
- Alcohol consumption: Alcohol Use Identification Test-Consumption (AUDIT-C), based on ICD-10 criteria for hazardous alcohol use[194].
- Problematic social media use: Bergen Social Media Addiction Scale (BSMAS), based on the general core criteria of addiction: salience, mood modification, tolerance, withdrawal, conflict, and relapse[195].
- Burnout: Gothenburg Institute of Stress Medicine's Self-Reported Exhaustion Syndrome (s-ES) questionnaire, based on the Swedish Ministry of Health's diagnostic criteria for exhaustion syndrome included in the Swedish ICD-10[196].
- Problem gambling: Problem Gambling Severity Index (PGSI), based on core criteria for pathological gambling from the DSM-IV and ICD-10[197].

During initial visits, I and other researchers accompanied SICO representatives to present the study to the meeting attendees. For subsequent visits, SICO representatives presented the study to prospective participants following instructions provided by the research team. Data collection took place during the 2022–2023 pre- and regular season for male teams (August–February) and during the 2023–2024 regular season for female teams (January–February).

At each visit, the study was introduced to attending athletes during SICO's regular presentations. We then presented athletes with a quick-response code they could scan digitally using their mobile phones, which directed them to the survey platform. Participants first viewed a full description of the study alongside a consent form. Participants were required to provide digital informed consent and confirm that they were at least 16 years old before proceeding to the actual survey. A total of 648 participants entered the survey, provided digital informed consent, and responded to at least one section of the survey battery. We included all 648 participants in Study II and 628 participants in Study III, as 20 participants did not complete the PGSI, which was the principal variable of focus in Study III. We obtained ethical approval for these studies from the Swedish Ethical Review Authority (Dnr. 2019-03393). Given the recognizability and public profile of some participants, maintaining anonymity was a high priority. As a result, only limited demographic data were collected. Age was recorded as a binary variable, while other potentially relevant variables (e.g., education level, league, or team) were intentionally omitted to further protect participants' identities.

Table 6. Survey battery used in Study II/III

Symptom & measure	Items	Cut-offs
Depression Patient Health Questionnaire (PHQ-9)[185] Scored on 0-3 ordinal scales (Not at all to Nearly every day)	*Over the past 2 weeks, how often have you been bothered by the following problems?* 1. Little interest or pleasure in doing things 2. Feeling down, depressed, or hopeless 3. Trouble falling or staying asleep, or sleeping too much 4. Feeling tired or having little energy 5. Poor appetite or overeating 6. Feeling bad about yourself – or that you are a failure or have let yourself or your family down 7. Trouble concentrating on things, such as reading the newspaper or watching television 8. Moving or speaking so slowly that other people could have noticed? Or so fidgety or restless that you have been moving a lot more than usual 9. Thoughts that you would be better off dead, or thoughts of hurting yourself in some way	Range 0-27 Mild 5-9 Moderate/severe 10-27
Anxiety Generalized Anxiety Disorder Questionnaire (GAD-7)[186] Scored on 0-3 ordinal scales (Not at all to Nearly every day)	*Over the past 2 weeks, how often have you been bothered by the following problems?* 1. Feeling nervous anxious, or on edge 2. Not being able to stop or control worrying 3. Worrying too much about different things 4. Trouble relaxing 5. Being so restless that it's hard to sit still 6. Becoming easily annoyed or irritable 7. Feeling afraid as if something awful might happen	Range 0-21 Mild 5-9 Moderate/severe 10-21
Alcohol consumption Alcohol Use Disorder Identification Test, Consumption (AUDIT-C)[194] Scored on 0-4 ordinal scales	In the past year… 1. How often did you have a drink containing alcohol? (Never to 4+ times/week) 2. How many drinks containing alcohol did you have on a typical day when you were drinking? (1-2 to 10+) 3. How often did you have 4 (female)/ 5 (male) or more drinks on one occasion? (Never to Daily or almost daily)	Range 0-12 Hazardous 6-12, males 4-12, females
Problematic social media use Bergen Social Media Addiction Scale (BSMAS)[195] Scored on 0-5 ordinal scales (Never to Very Often)	*Considering the past 12 months, how often did you…* 1. …spend a lot of time thinking about or planning using social media? 2. …feel an urge to use social media more and more? 3. …use social media to forget about personal problems? 4. …try to cut down on the use of social media without success? 5. …get troubled by being prohibited from social media use? 6. …negatively impacted your life as a hockey player/other parts of your life?	Range 0-30 At-risk 14-25 Problem use 26-30
Burnout Gothenburg Institute of Stress Medicine's Self-Reported Exhaustion Syndrome questionnaire (s-ES)[196] Binary (yes/no) scales	1. Have you felt mentally and/or physically exhausted for more than 2 weeks? 2. Is this fatigue coming from being under pressure for a period of time that is longer than 6 months? *During the last 2 weeks, have you experienced…* 3. (a) Difficulties concentrating or loss of memory? (b) Highly reduced capability to perform whenever there is short amounts of time? (c) Being emotionally unstable or irritable? (d) Trouble sleeping? (e) That you've felt physically weak or that you easily become exhausted? (f) Physical problems such as chest pains, heart palpitations, stomach aches, vertigo, increased sensibility to sound or pain somewhere? 4. Have these things (questions 1-3) reduced your wellbeing and level of function (performance in ice-hockey, ability to work, family life, hobbies or in other important situations)?	At-risk q1 or q2 + 4 or more q3 items OR both q1 & q2 + 3 q3 items Clinical burnout Both q1 & q2 + 4 or more q3 items + q4
Problem gambling Problem Gambling Severity Index (PGSI)[197] Scored on 0-3 ordinal scales (Never to Always)	*Considering the past 12 months…* 1. …have you bet more than you could really afford to lose? 2. …have you needed to gamble with larger amounts of money to get the same feeling of excitement? 3. …have you gone back on another day to try to win back the money you lost? 4. …have you borrowed money or sold anything to gamble? 5. …have you felt that you might have a problem with gambling? 6. …have people criticized your betting or told you that you had a gambling problem, whether or not you though it was true? 7. …have you felt guilt about the way you gamble or what happens when you gamble? 8. …has gambling caused you any health problems, including stress or anxiety? 9. …has your gambling caused any financial problems for you or your household?	Range 0-27 At-risk 1-2 Moderate-risk 3-7 Problem 8-27

Statistical analysis

Based on previous literature, we hypothesized that (1) elite ice hockey players would exhibit less depression and anxiety symptom burden and more hazardous alcohol use and problematic gambling compared to general population and athlete samples, and (2) concussion history would be associated with elevated adverse mental health symptoms, defined as symptoms meeting at-least mild or at-risk severity. To address hypotheses included in Study II, we deployed Chi-square and Fisher exact tests to test differences between prevalence rates across studies, ANOVA and Kruskal-Wallis with Dunn tests to test differences across concussion history groups and continuous symptom burden, and finally logistic regressions to test differences in the likelihood of screening for elevated mental health symptom burden by concussion history group while controlling for covariates (sex, age, previous learning disorder or ADHD diagnoses). In Study III, we took an alternative approach by stratifying participants based on their problem gambling severity (no/low-risk vs. moderate-risk/problem gambling). We then used Student's *t*-tests, Chi-square tests, Fisher exact tests, ordinal regression (proportional odds), and count regression (negative binomial models) to assess differences between groups across demographic, sports-related, and adverse mental health variables.

I conducted several reanalyses for both studies. In Study II, I applied count regression models to examine the association between concussion history and adverse mental health outcomes as continuous variables, replacing the original nonparametric tests. Similarly, in Study III, I utilized count regression models to assess the relationship between PGSI scores and adverse mental health symptom burden, treating both as continuous variables.

Study IV

Setting and participants

This study was conducted in collaboration with the Malmö Psychiatric Outpatient Clinic for Elite Sport and Health. Situated in central Malmö, the clinic accepts referrals from athletes and sports staff aged 15 years or older who are active in the top two divisions of their respective sport. Exceptions are made for sports that do not adhere to a divisional system. In accordance with the cost structure of other specialist psychiatric care services in Sweden, care is provided free of charge for individuals under the age of 20, while those aged 20 years or older pay approximately 200 SEK per visit.

Design and procedure

To address our study aims, we utilized a mixed-method design, combining quantitative and qualitative research methods. First, we conducted a retrospective medical record review of patients who had sought care at the clinic since its

inception. We utilized data already collected from a previous study as well as more recent data from patients who have sought care since May 2021 and used the 1177 platform, Sweden's national patient portal. Through 1177, we notified these patients of the study and provided a 12-week opt-out period. Three patients opted out of the medical record review, leaving a total of 96 participants for the quantitative analysis. After obtaining permission from the regional healthcare system, I accessed records for patients who have sought care May 2021 to March 2024 and for whom we did not have data for from an earlier study[198] via the Melior journal system. On a group level, we described the distribution of demographic variables (age, sex, sport type), diagnoses (primary and secondary), and referral routes.

Second, we invited former and current patients to participate in semi-structured interviews to explore their experiences of mental health issues, the help-seeking process, and the quality of the treatment they received. Prospective participants were offered the option to be interviewed either at the clinic in private meeting rooms or online via Teams. Interviews were recorded using an audio recording device and later transcribed verbatim. None of the interviewers had prior relationships with the patients. To avoid contacting patients who had not been in touch with the clinic for an extended period, we only invited patients who had been in contact since May 2021. Patients currently receiving treatment were also eligible and were recruited through their primary therapist. Of the 36 invited patients, 15 participated in interviews starting in November 2024 and ending in January 2025. Dr. Claesdotter-Knutsson (a child and adolescent psychiatrist) and I (a research psychologist) conducted the interviews, with the former leading the majority while I took field notes and posed supplemental questions. Dr. Rahim and I later relistened to the audio recordings and transcribed them verbatim in the original language. I conducted a preliminary thematic analysis after 11 interviews, concluding that additional interviews were needed to reach data saturation. Data saturation occurs when no new information or themes emerge during data collection. The point of saturation is also influenced by the study's information power, which refers to the depth and richness of the data and can reduce the number of interviews required. Given the relatively short duration of the interviews (M = 35min ± 6), more interviews were necessary to ensure comprehensive data collection.

The majority of non-participants were not invited (n = 26), did not respond to our calls/messages (n = 13), declined (n = 5), did not respond after initially accepting (n = 2), or scheduled but did not attend (n = 1). We obtained ethical approval for this study from the Swedish Ethical Review Authority (Dnrs. 2020-05345; 2023-01112-01, 2024-01672-02, 2024-02850-02, 2024-05513-01). The study included data from a previously published study, and separate ethical permits were obtained for each component of the study (i.e., quantitative and qualitative parts).

Analysis

The quantitative analysis portion of this study was descriptive in nature, but we did test differences in age at treatment uptake, hypothesizing that females would seek care at a younger age than males, which we tested using Student's *t*-test. To address our qualitative research questions, Dr. Claesdotter-Knutsson and I independently conducted three separate thematic analyses following Braun and Clarke's guidelines[199]. We meticulously read each transcript, made detailed notes, and identified key quotations representing the phenomenological essence of participants' experiences. Using semantic and latent coding strategies, we generated themes with NVivo software. We then convened to discuss, refine, and reach consensus on the final themes. I subsequently pseudonymized the data and translated all Swedish data into English, which was back-translated into Swedish by a bilingual third-party. We resolved any discrepancies through discussion, refining the translated quotes to preserve the meaning and style of the original speech. I then presented the themes and findings to the remaining authors and fielded feedback in terms of interpretation.

Results

Study I

The final 2021 sample (n = 7021) consisted of student-athletes representing 149 schools and 48 sports, of which soccer, handball, and floorball were most common (13.9% RIG-level). The final 2022 sample (n = 6228) consisted of student-athletes representing 148 schools and 48 sports, of which soccer, floorball, and basketball were most common (15.6% RIG-level).

As shown in Table 2 of the original article, 19.8% of participants screened positive for clinically significant depression (PHQ-2 ≥ 3) in 2021, compared to 17.8% in 2022, indicating strong evidence for a small difference, RD = -2.0% [95% CI -3.4, -0.7], p_{adj}=.008. In the original article, I reported that mean PHQ-2 scores declined significantly between 2021 (M_{2021} = 1.38 ± 1.52) and 2022 (M_{2022} = 1.25 ± 1.48), M_{diff} = -0.13 [95% CI -0.19,-0.08], p_{adj} < .001. Because there are only two ordinal items included in the PHQ-2, I have reanalyzed this using a more appropriate and robust test, a count regression model. Using a negative binomial regression, there was strong evidence that PHQ-2 symptom scores decreased by 10% from 2021 to 2022, SCR = 0.90 [95% CI 0.87,0.94], p < .001. Meanwhile, there was not sufficient evidence for a difference in clinically significant anxiety between 2021 (17.4%) and 2022 (18.4%), RD = 1.0% [95% CI -0.3,2.3%], p_{adj}=.18. In the original article, I reported that mean GAD-2 scores did not differ, (M_{2021} = 1.35 ± 1.57 vs. M_{2022} = 1.36 ± 1.59), M_{diff} = 0.01 [95% CI -0.05,0.06], p_{adj}=.84. Using a negative binomial regression, similarly, GAD-2 symptom scores did not differ from 2021 to 2022, SCR = 1.01 [95% CI 0.96,1.05], p = .79.

As illustrated in Figure 1 of the published article, significant reductions in clinically significant depression were observed among year 3 students (22.7% in 2021 vs. 18.0% in 2022) and year 4 students (24.0% in 2021 vs. 12.8% in 2022). Analyzing the school classes as cohorts, year 3 students in 2021 (22.6%) showed significantly higher depression rates compared to year 4 students in 2022 (12.8%). Anxiety rates also differed significantly across cohorts, with year 1 students in 2021 (15.4%) exhibiting lower rates than year 2 students in 2022 (19.2%), and year 2 students in 2021 (17.4%) exhibiting lower rates than year 3 students in 2022 (16.3%).

As detailed in Table 2 of the published article, fewer participants in 2022 self-reported pandemic-induced worsening of mental health 2021, with median scores differing significantly between years (P_{MWU} = .42 [95% CI .41, .43], p < .001). A more appropriate model would be an ordinal regression, namely a proportion odds logistic regression. Based on said model, student-athletes in the 2022 sample were less likely to report a stronger negative effect of the pandemic on their mental health than in 2021, OR = 0.55 [95% CI 0.52,0.59], p < .001. Similarly, I reported that concern over the pandemic's impact on sports careers was significantly lower in 2022 compared to 2021 (P_{MWU} = .41 [95% CI .40, .42], p < .001). Likewise, an ordinal regression may be more appropriate here, and according to the latter model, student-athletes in 2022 were, again, more likely to report dampened effect on their level of career worry (OR = 0.55 [95% CI 0.51, 0.59], p < .001). Despite this, the number of student-athletes who reported that they were excessively worried over their sporting career and considered quitting doubled (RR = 2.03 [95% CI 1.68, 2.46], p < .001). This effect was driven by year two (RR = 1.86 [95% CI 1.29, 2.68], $\chi^2(1) = 10.87$, p < .001) and year three (RR = 2.46 [95% CI 1.86, 3.25], $\chi^2(1) = 42.36$, p < .001) student-athletes, who were more likely to report that they may quit as opposed to being simply worried or unaffected.

I did not report the effect of sex and sport on the difference in positive screens in PHQ-2 or GAD-2. Post-hoc tests revealed that the decrease in overall depression prevalence may have been driven by males (16.4% in 2021 to 14.3% in 2022, RD = -2.1%, [95% CI -3.8, -0.5], p = .01), floorball athletes (21.5% in 2021 to 17.7% in 2022, RD = -3.8% [95% CI -7.6, -0.1], p = .046), figure skaters (30.8% in 2021 to 8.1% in 2022, RD = -22.7% [95% CI -42.5,-2.9], p = .04), and swimmers (26.8% in 2021 to 13.9% in 2022, RD = -12.9% [95% -21.7, -4.1] p = .005). On the other hand, while overall anxiety rates did not differ, females (RD = +3.1% [95% CI 0.8, 5.5], p = .009), handball athletes (16.5% in 2021 and 21.7% in 2022, RD = +5.2% [95% CI 0.1, 10.5], p = .043) and ice-hockey athletes (8.4% in 2021 and 19.3% in 2022, RD = +10.9% [95% CI 3.9, 17.9], p = .002) endorsed higher rates of anxiety in 2022 than 2021. Spaghetti plots in Figure 8 illustrate the change in proportions of positive screens from 2021 to 2022 by sport for depression (8A) and anxiety (8B).

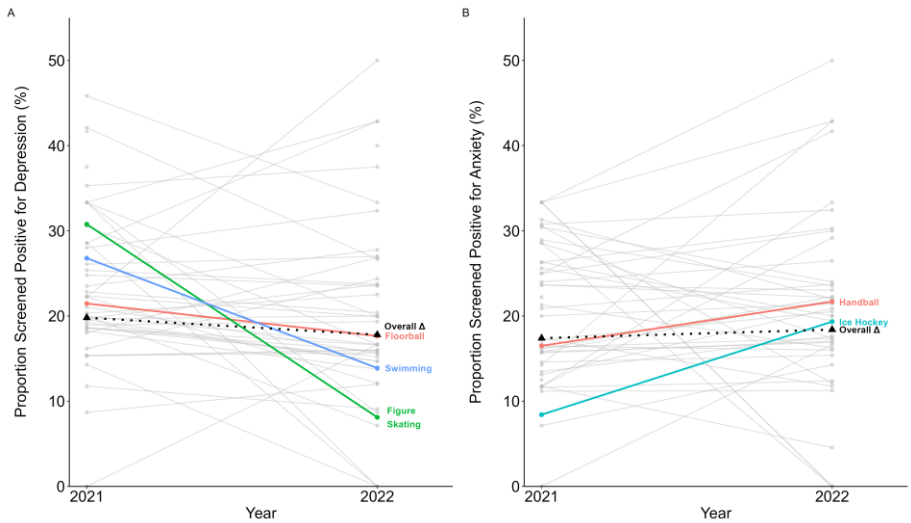

Figure 8. Change in depression and anxiety prevalence rates from 2021 to 2022 by sport
Highlighted sports significant based on Chi-square tests. Proportions of positive screens from 2021 to 2022 by sport for depression (A) and anxiety (B).

One can extend the analysis to account for data clustering by modeling the within-school and within-sport variability. This can be achieved by including random effects corresponding to schools and sports in a generalized linear mixed model. By doing so, one accounts for the non-independence of observations within these clusters, thereby partitioning the variance into within-cluster and between-cluster components. This approach not only refines the estimation of the overall effect but also enhances the robustness and validity of statistical inferences by mitigating potential biases arising from correlated data.

After doing so, our results remained consistent. Using a model with year as a fixed effect and sport and school as random effects, the change in depression prevalence from 2021 to 2022 was still statistically significant, albeit with slightly less statistical certainty (OR = 0.89, 95% CI [0.82, 0.98], $p = .012$). Likewise, the change in anxiety prevalence remained non-significant (OR = 1.07, 95% CI [0.98, 1.18], $p = .13$). Controlling for sex, class year, and team sport also produced similar results.

Interaction models including sport as a fixed effect replicated our findings, identifying the same sports as the primary drivers of the observed differences in depression and anxiety rates. When including sex as a fixed effect, males showed a significant decrease in depression between 2021 and 2022, while females did not. However, the interaction term between year and sex was not statistically significant, indicating that the difference in the magnitude of change between sexes was not robust enough to conclude a sex-specific pattern. For anxiety, neither males nor females showed significant year-to-year changes, and the interaction between year and sex was likewise non-significant.

As illustrated in Figure 2 of the original article, positive screens for depression and anxiety in 2021 and 2022 were examined using multiple logistic regression models separately. In contrast to the published model, I have made several modifications to enhance the robustness and interpretability of the estimates. Specifically, the reference group for perceived mental health change was changed from "Improvement" to "Unchanged," and for career worry from "Not worried" to "Indifferent," given that these categories represented larger groups and provided more stable estimates. Additionally, class year was treated as a categorical variable rather than continuous to allow for the assessment of potential non-linear effects.

Perceived mental health change due to the COVID-19 pandemic was strongly associated with endorsing clinically significant depression and anxiety in 2022 after controlling for covariates. In comparison to those that indicated their mental health was unchanged in 2022, those reporting that their health improved (OR = 2.21 [95% CI 1.59, 3.03], $p < .001$), got worse (OR = 1.81 [95% CI 1.54, 2.12], $p < .001$), or much worse (OR = 6.51 [95% CI 5.18, 8.18], $p < .001$) endorsed greater odds of endorsing clinically significant depressive symptoms after controlling for covariates. Likewise, compared to those that reported their mental health was unchanged in 2022, those reporting that their health improved (OR = 2.56 [95% CI 1.80, 3.58], $p < .001$), got worse (OR = 2.40 [95% CI 2.04, 2.83], $p < .001$), or much worse (OR = 8.60 [95% CI 6.79, 10.90], $p < .001$) endorsed greater odds of endorsing clinically significant anxiety symptoms after controlling for covariates.

Career worry was also associated with poor outcomes, particularly depression. In comparison to those that indicated they were indifferent about the pandemic's effects on the future of their career in sport, those that indicated they were very worried (OR = 1.47 [95% CI 1.04, 2.07], p .03) or that they may quit (OR = 1.94 [95% CI 1.44, 2.60], $p < .001$) were more likely to endorse clinically significant depression when controlling for covariates. For anxiety, only those who reported being indifferent to the pandemic's effects on their sporting career had significantly different odds of endorsing elevated anxiety levels in 2022, with lower odds observed (OR = 0.62 [95% CI 0.52, 0.74], $p < .001$).

Across both models, female sex was associated with greater odds of depression (OR = 1.50 [95% CI 1.31, 1.73], $p < .001$) and anxiety (OR = 2.74 [95% CI 2.37, 3.16], $p < .001$) in 2022. Class year was an influential variable on depression. Compared to students in their first year, students in their second year (OR = 0.84 [95% CI 0.72, 0.99], $p = .043$), third year (OR = 0.72 [95% CI 0.61, 0.86], $p < .001$), and fourth year (OR = 0.50 [95% CI 0.31, 0.78], $p = .003$) students endorsed higher odds of depression when controlling for covariates. While winter sport-athletes were not more likely to endorse depression in 2022, they were more likely to endorse anxiety (OR = 1.26 [95% CI 1.02, 1.56], $p = .03$).

In the original article, I briefly compared our model with that of a previously published study[200]. However, the present analyses allow for direct comparisons with the models from 2021. Notably, some associations differed between the two time points. In contrast to 2021, reporting improved mental health due to the pandemic was associated with higher odds of endorsing depression in 2022. Moreover, while no differences between class years were observed in 2021, students in their third and fourth years were less likely to endorse depression than first-year students in 2022. Regarding anxiety, athletes engaged in team sports were less likely to report clinically significant anxiety than those in individual or mixed sports in 2021, but this association was not present in 2022. Conversely, athletes participating in winter sports were more likely to endorse anxiety in 2022, a pattern not observed in 2021. Multiple logistic regression models illustrating the relationships between variables and depression and anxiety across both years are presented in Figure 9.

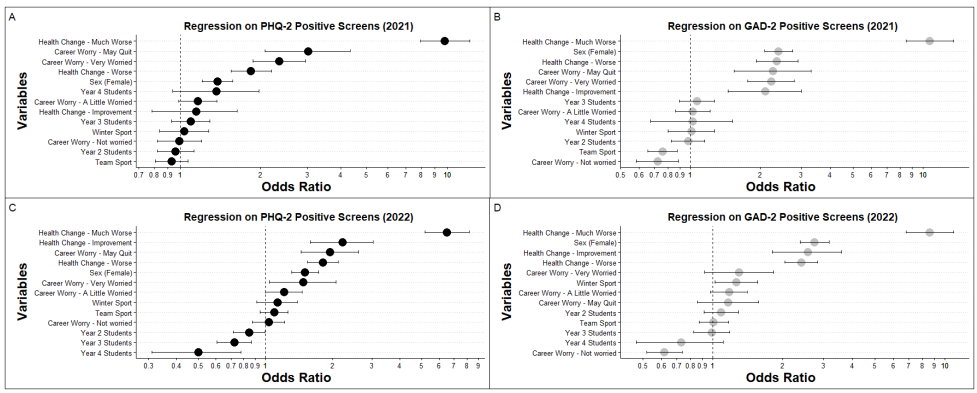

Figure 9. Multiple logistic regressions on depression and anxiety screening in 2021 and 2022.

(A) Multiple logistic regression on PHQ-2 positive screens in 2021, (B) logistic regression on GAD-2 positive screens in 2021, (C) Logistic regression on PHQ-2 positive screens in 2022, (D) logistic regression on GAD-2 positive screens in 2022. All estimates are controlled for the remaining variables in the model.

Study II

In total, 648 participants from the SHL, HA, and SWHL were included in Study II. Among males, of which made up the majority, most were 26 years or older and completed the survey in Swedish. Among females, the majority were 25 years or younger and completed the survey in English. A condensed version of the published table detailing sample characteristics is presented in Table 7 (See Table 1 in the published article for full details).

Table 7. Sample characteristics by sex and overall

Variable	Male (*n* = 468)	Female (*n* = 180)	Total (*n* = 648)
Age 26+, V%	56.0%	22.2%	46.6%
Language Swedish, V%	95.5%	59.4%	85.5%
Concussive events, *Mdn* [Q1-Q3]	1.0 [0.0, 3.0]	0.0 [0.0, 2.0]	1.0 [0.0, 2.0]
Hazardous alcohol consumption, V%	29.5%	36.4%	31.4%
Problematic social media use, V%	0.0%	1.2%	0.3%
Moderate-severe depression, V%	1.6%	15.0%	5.3%
Moderate-severe anxiety, V%	1.6%	10.4%	4.0%
Clinical burnout, V%	4.0%	19.1%	8.2%

Note. Binary outcomes presented as valid percentages (V%). Numeric variables described using medians (*Mdn*) and quartiles (Q1-Q3).

As was published in the original article, hazardous alcohol consumption based on AUDIT-C scores was the most common adverse mental health outcome for both sexes, followed by clinically significant burnout symptoms according to the s-ES, moderate-to-severe depression according to the PHQ-9 and moderate-to-severe anxiety according to the GAD-7 (Table 7). Evaluating subclinical symptom burden, the combination of at least mild anxiety, mild depression, and at-risk burnout was the most common comorbidity profile, followed by the combination of mild depression and hazardous alcohol consumption (See Figure 1 of the published article).

Prevalence rates of the various mental health outcomes were compared to those from other studies from the general population and other athlete samples stratified by sex (See Table 2 of the published article). Two Swedish studies were chosen to compare rates of hazardous alcohol use to our sample of ice hockey athletes. Our male athletes endorsed higher prevalence (47.5%) compared to a sample of male Swedish national team athletes (27.7%[198]) and a sample of male employed adults in Sweden (35.7%[201]) after adjusting our cut-off to match theirs (AUDIT-C ≥ 5). Using the same studies for females, our sample endorsed higher prevalence (36.4%) than other female Swedish national team athletes (24.5%), but not female employed adults in Sweden (30.7%). Two general population studies, one from Sweden[202] and across several countries[203], were chosen to compare our rates of problematic social media use. The only difference was seen between our male athletes (1.1%) versus the Swedish general population sample (4.3%) after matching their cutoff (BSMAS ≥ 19). Two studies were used to compare prevalence of moderate-to-severe depression and anxiety with our sample, the same sample of Swedish national team athletes and

another study on residents of Sweden[35]. Only our male sample differed, reporting lower prevalence (1.6%) compared to the male national team athletes (6.6%) and male residential sample in Sweden (8.2%). Regarding anxiety, again, only our male sample differed, exhibiting lower prevalence compared to male national team athletes (1.6% vs. 6.5%) and, after matching their cut-off, the sample of male residents in Sweden (3.1% vs. 10.6%). One study was chosen to compare the rate of burnout in our sample versus a sample of employed adults in Sweden[204]. Only our female sample differed, exhibiting higher rates (19.1%) than females from the employed adult sample in Sweden (9.9%).

I have conducted additional correlation analyses to assess bivariate relationships between elevated adverse mental health symptoms and other binary sports-related and demographic variables (Figure 10). As expected, based on my earlier comorbidity analyses, clinically significant depression, anxiety, and burnout were highly correlated in both sexes. Of particular interest was the effect of language in burnout outcomes among females, as those who completed the survey in Swedish were more likely to endorse clinically significant burnout symptoms than those who completed it in English (28% vs. 6%, $p < .001$).

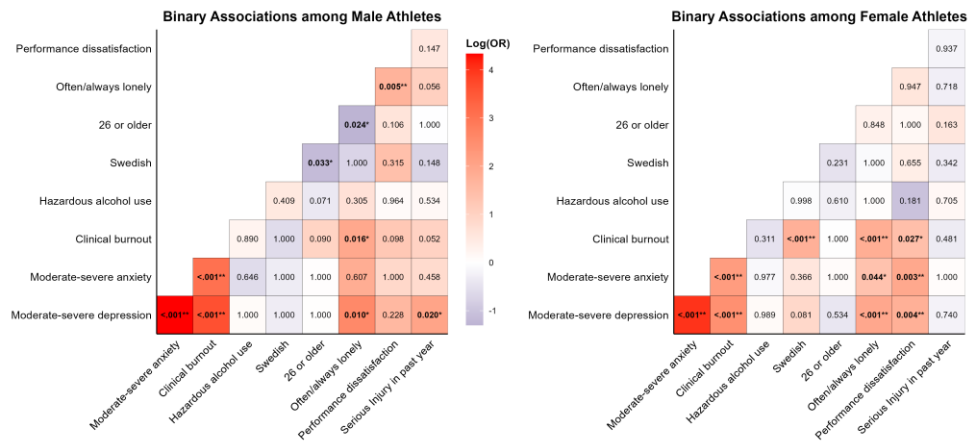

Figure 10. Strength of bivariate correlations between mental health outcomes and personal variables by sex.
Strength of association measured by *p*-values based on Chi-square tests for male and female athletes. Red indicates positive correlation and blue indicates negative correlation according to logarithmic of odds ratio, log(OR).

Finally, the effect of concussion was tested on mental health outcomes. To assess the raw relationship in the original article, analyses of variance and nonparametric Kruskal-Wallis with post-hoc Dunn tests were conducted from which differences were found (See Figure 2 of the published article). Instead of nonparametric tests, count regression models (i.e., a negative binomial regression) may have been more

appropriate and are reported here. First, I assessed the relationship between concussion history as a continuous variable with mental health measures as continuous outcome variables. Then, I stratified concussion history into three groups, as was done in the original article, and then reran the regressions with concussion history as categorical. In both cases, I will report the raw relationship, the relationship controlled for age, sex, and LD/ADHD diagnoses, as well as the odds ratio of the interaction term between sex and concussion history (Figure 11).

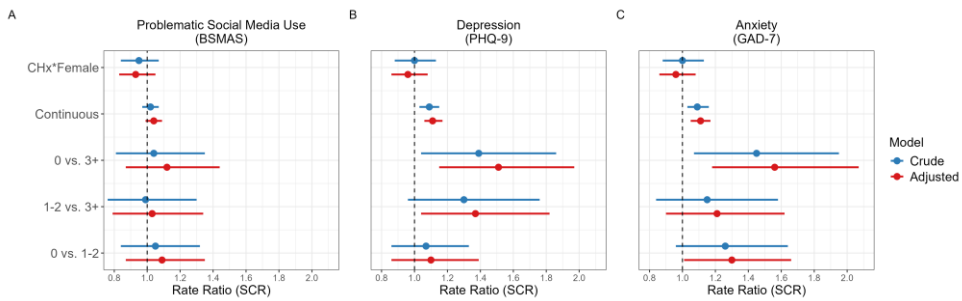

Figure 11. Negative binomial regression models assessing relationship between concussion history and mental health outcomes continuously

Symptom count ratios from crude and adjusted models for continuous problematic social media use (A), depression (B), and anxiety (C). SCR = symptom count ratio.

Based on this reanalysis, concussion history assessed on a continuous scale was positively correlated with depression (SCR = 1.11 [95% CI 1.06, 1.17], $p_{Tukey} < .001$) and anxiety (SCR = 1.11 [95% CI 1.05, 1.17], $p_{Tukey} < .001$) after controlling for covariates. After categorizing concussion history into three groups, those who reported three or more concussive events reported greater depressive (SCR = 1.51 [95% CI 1.15, 1.97], $p_{Tukey} < .001$) and anxiety (SCR = 1.56 [95% CI 1.18, 2.07], $p_{Tukey} < .001$) symptom burden compared to those who reported zero previous concussions. Only for depression did those who reported three or more endorse greater symptom burden than those who reported one or two (SCR = 1.37 [95% CI 1.04, 1.82], $p_{Tukey} = .021$).

Next, as was done in the original article, I conducted binary logistic regressions to assess the strength of the relationship between concussion history categorically (0, 1-2, 3+) and continuous on the likelihood of screening for at least mild or at-risk mental health outcomes. Interestingly, concussion history treated as a continuous variable was positively correlated with all mental health outcomes, except for hazardous alcohol consumption. Treating concussion history as a categorical variable revealed the strongest differences between those that sustained zero concussions versus those that reported three or more. Those reporting three or more were also more likely to endorse elevated symptoms of anxiety and depression than

those who reported one or two prior concussions. The only interaction term that indicated a significant difference was that in the model with at-risk/problematic social media use as the outcome, indicating that the effect of concussion history on the outcome was significantly stronger among males than females.

Study III

In contrast to Study II, Study III included 628 participants, as seven female participants and 13 male participants did not complete PGSI items. Approximately 11.9% of the male participants and 0% of the female participants met the threshold for moderate-risk or problem gambling. As reported in the original article, the male sample was stratified into two groups based on gambling severity: a no/low-risk group (PGSI score 0–2) and a moderate-risk/problem gambling group (PGSI ≥ 3). These groups were subsequently compared across demographic, sports-related, and mental health variables.

Athletes classified as moderate-risk/problem gamblers reported significantly higher AUDIT-C scores and a greater prevalence of hazardous drinking compared to the no/low-risk group. Moreover, they exhibited greater depressive symptom severity and were more likely to meet the threshold for at least mild depressive symptoms. However, there was insufficient evidence to support a group difference in meeting the threshold for moderate-to-severe depressive symptoms. Similarly, moderate-risk/problem gamblers demonstrated greater anxiety symptom burden, and although the evidence was less robust, they tended to report at least mild anxiety symptoms as well as moderate-to-severe anxiety symptoms. No significant group differences were observed with regard to age, previous concussions with LOC or PTA, or performance satisfaction.

To add to the published analyses, I conducted a reanalysis treating PGSI symptoms as a continuous outcome and modeling them with count regression (i.e., negative binomial regression) in the male sample. Based on these reanalyses, positive correlations were seen with alcohol consumption (SCR = 1.29 [95% CI 1.10, 1.51], $p < .001$), depressive symptoms (SCR = 1.26 [95% CI 1.15, 1.40], $p < .001$), and anxiety symptoms (SCR = 1.22 [95% CI 1.10, 1.36], $p < .001$). Age-adjusted models produced similar results. These relationships are illustrated in Figure 12.

These findings offer a broader perspective, suggesting that the relationship between PGSI scores and adverse mental health symptoms is not limited to those identified as moderate-risk or problem gamblers. Instead, a general positive correlation is observed across the entire sample, indicating that higher PGSI scores are associated with greater mental health difficulties, even among individuals with lower-risk gambling behaviors.

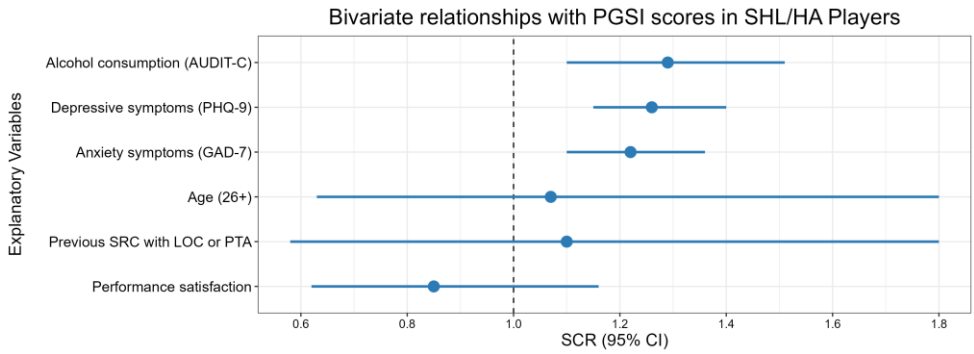

Figure 12. Bivariate relationships based on negative binomial models with PGSI as continuous outcome.

Negative binomial models with single explanatory variable and PGSI as continuous outcome. PGSI = Problem gambling severity index. SRC = sports-related concussion, LOC = loss of consciousness, PTA = post-traumatic

Study IV

In Study IV, 96 participants were included in the retrospective medical journal review. Females made up approximately 71% of the sample, while active athletes (as opposed to staff) made up 87%. Patients were on average 29 years old (*SD* = 8) and had first sought care at the age of 25 (*SD* = 7). Females tended to initiate treatment at the clinic earlier than males. Patients engaged in a range of sports, with just over one-half participating in team sports while the remaining engaging in individual- or mixed-sports. An overwhelming majority made contact with the clinic through self-referral.

A review of patients' primary and secondary diagnoses revealed that stress-related and somatoform disorders (F40-F49) were the most common, assigned to over half of the patients. Within this category, mixed anxiety and depressive disorder (F41.2) was the most prevalent diagnosis, given to one-third of those receiving an F40-F49 diagnosis. Affective disorders (F30-F39) were the second most common diagnostic family, affecting 17% of patients, with unspecified major depressive disorder, single episode representing over three-quarters of the diagnoses within this category. Unspecified disorders, including F999, R458, Z004, and Z039 codes, accounted for 16% of patients. The fourth most common diagnostic family was behavioral syndromes (F50-F59), assigned to 15% of patients. Within this group, unspecified anorexia nervosa and other eating disorders were the predominant diagnoses. The remaining 5% of patients received mental health diagnoses outside of these primary diagnostic categories.

For the qualitative part of Study IV, we interviewed 15 current and former patients of the clinic—comprising active athletes, staff, and individuals no longer in active roles—using purposeful sampling to ensure diversity that mirrored the wider patient population in terms of diagnoses and sports.

In our first thematic analysis, which examined how participants experienced adverse mental health symptoms in elite sport, we identified three main themes: internal struggles, external pressures, and sports culture. The theme of internal struggles described how poor mental health develops and manifests internally and included three subthemes: physical and emotional strain, maladaptive coping, and diminished well-being. Physical and emotional strain encompassed the diverse ways in which rising demands from individuals' interactions with their environment led to overwhelming stress on both body and mind, with many participants sustaining injuries and playing through them—an experience that took a significant toll physically and mentally—while also experiencing energy depletion, reduced social connection, and the emergence of social or agoraphobic tendencies. Maladaptive coping was evident as many athletes resorted to problem-oriented strategies in the face of unmodifiable stressors, which ultimately fostered patterns of learned helplessness and self-loathing, and diminished well-being captured the parallel decline in overall health, marked by anhedonia and pervasive pessimism in work and personal life. External pressures, defined as the influence of environmental stressors and individual perceptions in creating conditions conducive to mental illness, included the subthemes of work-life balance, life circumstances, and social and public pressures. Work-life balance entailed the challenges some athletes faced in juggling a sporting career with other endeavors—especially those engaged in sports with less financial backing—with several athletes feeling defeated by the seemingly impossible task of maintaining elite status while remaining financially independent over the long term; life circumstances referred to how significant changes in daily life, such as those occasioned by COVID-19 or moving from home, disrupted established routines and critically undermined mental health; and social and public pressures reflected the perceived external demands on their performance, where initial motivation from pressure eventually gave way to overwhelming stress. The theme of sports culture, defined as the uniquely influential aspects of the sporting environment on mental health, was articulated through the subthemes of privacy within teams, coaches, clubs, and sponsors, and competitive drive and identity. Privacy within teams highlighted the varying levels of comfort individuals felt in discussing mental health—some confiding in a select few, while others feared that disclosure could jeopardize their standing—whereas coaches, clubs, and sponsors described the external expectations and pressures imposed by key stakeholders, and competitive drive and identity underscored both the relentless pursuit of perfection and the subsequent pain associated with letting go of an athletic identity in later career phases.

In our second thematic analysis, which sought to understand the barriers and facilitators to seeking help for mental health among elite athletes, we identified three main themes: mental health perceptions, logistical aspects, and support systems. Mental health perceptions encompassed both individuals' mental health literacy and

attitudes. The subtheme of perceived stigma and social expectations highlighted how the tough, perfectionistic athlete identity often led participants to minimize or dismiss their struggles. Meanwhile, the subtheme of individual awareness and motivation revealed that many athletes either failed to recognize their mental health issues or believed that their concerns were innocuous and did not warrant clinical intervention. Logistical aspects, the second main theme, refer to the complications during the process from deciding to seek treatment to actually accessing care. The first subtheme, service accessibility, referred to the multitude of steps—from locating a clinic and waiting in line to booking an appointment—that deterred many, while the second theme, awareness and eligibility, highlighted the confusion or lack of knowledge regarding available resources and qualifications. The third theme, economic and geographic accessibility, detailed financial challenges and the mixed perceptions regarding the quality of remote treatment options. The final main theme, support systems, captured the role of informal and institutional networks in facilitating help-seeking. The first subtheme, informal support, entailed support garnered from friends, family, and teachers. Many participants recalled that their journey toward help-seeking began with confiding in those closest to them. The second subtheme, institutional support, encompassed assistance from coaches, clubs, and federations. While some participants reported receiving adequate support, others experienced the opposite, with some even encountering counterproductive responses.

The final thematic analysis examined participants' perceptions of the quality of mental health care they received at the sports-specialized clinic and identified two main themes: treatment approach and access and availability. The treatment approach theme described the clinic's and clinicians' style and expectations when interacting with patients, with the first subtheme, patient accountability, indicating that some patients felt a need for clinicians to motivate them toward taking charge of their treatment. The second subtheme, feasibility and pace, reflected the belief among many athletes that, although the pace of treatment was slow, it ultimately may have been in their best interest. The third subtheme, patient-clinician alliance, emphasized the perceived benefit of having therapists with a sports background over those without such expertise. The second main theme, access and availability, was defined as the relative ease of contacting the clinic and scheduling care. The first subtheme, waiting time, referred to the delays some participants experienced before receiving care—delays that were seen as hindrances to progress. The second subtheme, limited availability, described the restricted days on which therapists were accessible, which some felt undermined their treatment progress. The final subtheme, technological challenges, highlighted the difficulties encountered when navigating platforms such as the 1177 system, especially in emergencies or for general contact.

Discussion

In this collection of studies, we explored the epidemiology, risk factors, and lived experiences of adverse mental health experiences within elite sports. Employing a range of quantitative and qualitative methodologies, our research delved into how various risk factors, such as the COVID-19 pandemic and SRCs, contribute to mental health challenges in elite sports environments. Our findings reveal robust associations and comorbidity between these risk factors and outcomes like depression, anxiety, burnout, and problem gambling, with variations observed across sex, sport, and other contextual dimensions. These nuanced insights not only advance our understanding of the intricate factors underlying mental health in sports but also underscore the need for tailored interventions. By identifying critical points for intervention, such as enhancing mental health screening, providing sport-specific support services, and addressing stigma around help-seeking, our work paves the way for future initiatives aimed at promoting both the short- and long-term well-being and performance of those engaged in elite sports.

Study-specific discussion

Study I

In Study I, we observed a 2% reduction in the prevalence of clinically relevant depressive symptoms among elite high-school student-athletes from February 2021 (the height of the pandemic) to February 2022 (removal of COVID-19 restrictions). Athletes who reported that the pandemic had a negative impact on their mental health and elicited career-related worry were most likely to exhibit elevated depressive symptoms in 2022. Conversely, no significant change was detected in the prevalence of anxiety across years. Similar to the depression models, those who experienced a negative impact on their mental health and heightened career worry were more likely to report elevated anxiety symptoms in 2022. In both models, female sex was associated with greater odds of depression and anxiety after adjusting for covariates. Interestingly, athletes who perceived the pandemic as having a positive impact on their mental health also exhibited higher odds of depression and anxiety in 2022, suggesting that the removal of pandemic-related stressors may have introduced new or previously dormant ones.

In this thesis, I replicated our findings using more robust tests. In addition, I explored the effect of sex and sport on the change in prevalence from year to year. Males seemed to drive the drop in depression prevalence, while females tended to drive the non-significant rise in anxiety symptoms. Likewise, athletes competing in floorball, swimming, and figure skating drove depression prevalence down, while handball and ice-hockey drove anxiety levels up. The elevated depression prevalence noted in 2021 may be the result of the coinciding increased spread of COVID-19 within these sports during the winter of 2020-2021, as reported by the Swedish Sports Confederation[108]. Notably, these five sports are normally performed indoors, where virus spread was more likely to occur[88].

In the original article, we proposed that the resumption of sports training and competition across all levels, including the elite high school student-athletes in our sample, may have contributed to the observed decrease in depression prevalence from 2021 to 2022. In the absence of pre-pandemic baseline data, we still cannot ascertain whether this decline represents a full return to baseline, a regression toward baseline, or a drop below baseline levels. Previous studies indicate that the initial surge in adverse mental health symptoms during the early stages of the pandemic had largely rebounded by mid-2021[112-114], meaning that rates may have been still elevated in our 2021 sample. Accordingly, it is plausible that the decrease we observe reflects a decline from an elevated pandemic level, though the precise magnitude of this drop remains uncertain. While the 2% reduction in depression prevalence is statistically significant, its modest scale may be viewed as a positive outcome given the broader societal disruptions of the pandemic. This relatively small decline—equating to several hundred fewer cases of clinically relevant depression throughout the country in the population—could be interpreted as a testament to the efficacy of public health measures during the pandemic, suggesting that the lives likely saved through such policies outweighed the associated mental health consequences.

From the perspective of cognitive theory, specifically Lazarus and Folkman's[205] transactional model of stress, the lifting of restrictions can be interpreted as the removal of an overarching environmental stimulus that elicited stress among student-athletes who perceived it as a threat. The absence of this external stressor may have temporarily alleviated psychological strain, as fewer demands required active coping. However, the return to daily life may have simultaneously reintroduced pre-pandemic stressors or introduced new demands, resulting in greater overall stress compared to life during the pandemic. This interpretation is bolstered by the multiple logistic regression models, which indicated that individuals who perceived themselves as better off during the pandemic were more likely to screen positively for depression following the easing of restrictions compared to those who felt their mental health was unaffected by the pandemic. In line with the transactional model, these individuals may have appraised the

pandemic-related restrictions as benign or even beneficial, requiring no further cognitive appraisal or deployment of coping strategies. Consequently, the transition back to regular life may have represented a shift from a period of relative stability to one of compounding psychological strain.

Interestingly, while the prevalence of clinically relevant anxiety symptoms remained stable across the study period—if not slightly increased—the proportion of student-athletes reporting lost motivation and intentions to quit their sporting career doubled from 2021 to 2022. This may reflect lingering psychological consequences of the pandemic, as many student-athletes, primarily students in the middle or at the end of their high school athletic-careers, may have perceived that the disruption in training inhibited their chances of pursuing a professional sports career[116,200]. Although Sweden deployed comparatively lenient pandemic restrictions, thus allowing greater access to training facilities than in many other countries[106-107], this does not preclude their subjective perception of delayed athletic development, particularly among athletes who regarded the pandemic as a critical period for skill progression. For those affected by cancelled competitions and missed opportunities for exposure to scouts, the sense of having been denied a fair chance to realize their athletic potential may have exacerbated career-related worries[116]. From the perspective of self-determination and self-actualization theory[69], these disruptions likely thwarted athletes' autonomy and perceived level of competence in pursuing long-term goals, thereby impeding their path toward self-actualization and potentially contributing to heightened anxiety symptoms.

From the perspective of Team Denmark's Applied Model of Athlete Mental Health[60], the COVID-19 pandemic introduced multifaceted challenges across multiple ecological layers. At the macrosystem level, encompassing the Swedish societal and cultural context as well as daily life challenges, the Swedish collective mindset was put under pressure. The governmental response, which emphasized individual responsibility for adherence to public health recommendations, may have granted greater autonomy and control over their environment. However, this strategy also provoked considerable criticism[98-99,101-102] and the ensuing "war of information", characterized by conflicting perspectives and conjecture sometimes unanchored in scientific evidence may have fostered uncertainty and eroded trust in governmental institutions. Additionally, the athlete's everyday life was profoundly affected: Social contact became remote, established priorities were either altered or abandoned, and familiar routines were completely upended. Stevens and colleagues'[59] Social Identity Model may even offer a complementary lens. The pandemic-induced career concerns and weakened social connections stemming from distance learning measures and cancelled training sessions could have eroded athletes' social identities. This disruption in their connection to the team, personal self-concept, and athlete identity may have precipitated the psychological distress and explain these differences.

Within the exosystem, which includes leadership within the sports domain, administrators and coaches were thrust into the spotlight with minimal guidance. They were compelled to rapidly assimilate government and federation recommendations, devise protocols for safely organizing training and competitions, and establish procedures for responding to positive COVID-19 cases. Simultaneously, they had to evaluate the impact of training absences on team dynamics and individual standings while navigating divergent beliefs about the legitimacy of COVID-19. At the mesosystem level, representing the athlete's immediate training environment, disruptions were pronounced. Cancelled sessions and restrictions on the number of athletes per session contributed to an atmosphere of uncertainty[116], as frequently changing guidelines led to unpredictable adjustments in training schedules[104]. At the microsystem level, the individual athlete was directly impacted according to our data indicating that many athletes self-reported worsened mental health and heightened career-related concerns due to the pandemic. The compounded effects of disrupted social support networks and altered daily routines likely contributed to a state of languishing, characterized by a loss of meaning, diminished energy, and the emergence of adverse mental health symptoms[60]. Collectively, these challenges across the ecological spectrum underscore how the pandemic not only disrupted Sweden's broader societal structures but also the intimate, everyday contexts essential for sustaining athlete mental health and well-being.

Study II

In Study II, we found that the prevalence of several adverse mental health outcomes among elite ice hockey athletes differed from both general population samples and other athlete cohorts, which is in line with some studies but belies others[37-44]. Male athletes were less likely to report problematic social media use[202] and clinically significant symptoms of depression and anxiety[35,40]. In contrast, female athletes were more likely to endorse clinically significant symptoms of burnout[204], a finding not previously described elsewhere to our knowledge. Together, both male and female athletes exhibited a higher prevalence of hazardous alcohol consumption compared to other elite athlete samples[22,38], with male athletes also reporting a higher prevalence than employed adults in the general population[201]. Meanwhile, elevated symptom burden was positively correlated with cumulative SRCs, with the strongest effects seen after sustaining three or more concussions[166-168, 171-172]. These effects did not differ by sex and were controlled for age and previous learning and attention deficit hyperactivity disorders, which corroborates previous research, but challenges the theory that females are more severely affected by SRC-injuries[169].

These findings suggested that male elite athletes may be more mentally healthy compared to other populations, while female athletes demonstrated similar mental health profiles to both their athlete and general population counterparts, but may

experience greater workload imbalances, as reflected by elevated burnout symptoms. However, there may be additional psychosocial reasons for these discrepancies. Male athletes may underreport adverse mental health symptoms due to their strong adherence to athlete identity, which often emphasizes hypermasculinity and mental toughness, perpetuating stigma around experiencing poor mental health and seeking help for it[1]. On the other hand, a culture that glorifies alcohol consumption[38] may lead participants to accurately report their alcohol consumption, or even overreport it.

As expected, there was significant comorbidity between depression, anxiety, and burnout. While these conditions are distinct diagnoses, the survey batteries and symptom presentations show considerable overlap[9-10,185-186,196]. Notably, female athletes exhibited a higher prevalence of clinically relevant burnout symptoms compared to a general population sample[204], particularly among those who completed the survey in Swedish. This trend may reflect economic challenges and disparities between the male and female leagues as well as within the SWHL itself that warrant further investigation and action. Meanwhile, previous research in this population suggests that fewer than a quarter of SWHL players consider ice hockey their primary occupation, with most balancing full-time work or studies alongside their professional careers[192]. The demands of an elite sports career—extensive travel, rigorous training, and intense competition—combined with academic or occupational responsibilities, may be unsustainable for some athletes. From a stress theory perspective, prolonged exposure to these environmental stressors may exhaust coping resources, eventually leading to a state of energy depletion and helplessness[205]. Biologically, this chronic stress could dysregulate monoamine neurotransmission (e.g., serotonin), contributing to burnout and comorbid conditions such as depression and anxiety. Furthermore, the difference between those who completed the survey in Swedish versus English may reflect variations in survey interpretation or genuine differences in morbidity between domestic and international players. According to SICO, imported players often earn higher salaries than their Swedish counterparts irrespective of skill level, which could partly explain this disparity. This highlights not only a significant gender pay gap in elite ice hockey but also potential economic inequities between domestic and international players, which may undermine the sporting confederation's egalitarian ideals.

The elevated rates of hazardous alcohol consumption in both sexes may point to a cultural ethos within ice hockey where alcohol use is more socially accepted and potentially reinforced within the elite sports environment[38]. As discussed in the original article, increased alcohol consumption is associated with a range of long-term health risks, although how these risks interact with the physical fitness and cultural norms of elite sports remains unclear. Some studies suggest that active elite athletes consume more alcohol than their non-athlete counterparts, yet their drinking

tends to decrease over time after retirement, and they are less likely to be hospitalized for alcohol-attributable reasons[206-207]. This pattern may reflect that alcohol consumption in elite sports may often occur in social team settings[38], which in turn become more infrequent after retiring when athletes are no longer embedded in the team environment. However, the same studies indicate that athletes whose careers are prematurely ended by injury may engage in heavy drinking as a maladaptive coping mechanism, particularly if they disengage from sports entirely following career termination[206]. This does not mean that efforts to reduce drinking should be disregarded in these populations. Notably, the harms associated with excessive alcohol consumption can be both immediate and physical, as well as delayed and psychological.

Concussion history was positively associated with each adverse mental health outcome, except for hazardous alcohol consumption. The strongest evidence of an association was seen between concussion and elevated symptoms of depression, anxiety, and burnout. This may be indicative of biological aberrations as a result of multiple concussions, including prolonged inflammatory responses and disrupted neuronal network functioning, precipitating the onset of these symptoms. This corroborates previous research identifying this association[154,166-168,173], though our null findings between concussion history and hazardous alcohol consumption is inconsistent with other studies[168]. However, because this population was generally healthy, especially the males, we did not have ample statistical power to accurately provide estimates of the association between concussion history and clinically significant symptoms, as opposed to elevated symptoms at the at-risk or mild range at minimum[168]. The dearth of evidence for an association between cumulative concussions and alcohol consumption differs from what has been reported in earlier studies[168]. The biological mechanisms (or learning) mechanisms underlying the development of hazardous drinking are complex, but this lack of association may support learning theories of addiction[52-54] as opposed to the brain disease model[49-51].

Since this study focused on active elite ice hockey players, we did not measure or control for each participant's level of physical activity, as it was likely comparable across athletes in this sample. Along with other key modifiable health behaviors, such as diet quality and sleep duration, these factors may have attenuated the observed relationships to some extent[171-172]. This could confound our findings if the research question were strictly assessing whether cumulative concussions biologically cause psychiatric outcomes. However, as many researchers argue[169], SRCs function not only as biological stressors—causing neuroanatomical and functional changes—but also as psychosocial stressors that influence behavior and mental health. From the moment of injury to medical clearance, athletes undergo a psychologically demanding recovery process. The injury itself may be psychologically traumatic, and current management guidelines[158] entail temporary

removal from team activities (i.e., isolation), physical deconditioning, and acute symptoms of SRC, all of which can be mentally challenging. Additionally, the inability to progress through the RTS/RTL stages as expected may create further distress for athletes eager to resume their normal routines. Thus, while controlling for factors such as physical activity, sleep, and diet would have likely weakened the observed relationships between concussion history and adverse mental health outcomes, these changes are an inherent part of the concussion recovery process. As such, they are important considerations and are accounted for in our interpretation of the impact of concussion history on mental health outcomes, despite not being controlled for in our statistical analyses.

The implications for our findings concerning the link between concussion and elevated adverse mental health symptoms are vast. Having medical personnel educated on the latest guidelines pertaining to the detection, diagnosis, and management of SRC present at training and fixtures is of highest priority. Although this may not be an issue for the SHL and HA, previous research indicates that the level of medical support may be lacking in the SWHL[192]. Addressing these gender medical support gaps is essential. Likewise, investing in acute physiological and psychological interventions for SRC that mitigate symptom severity, along with ensuring accessible resources for individuals experiencing persistent symptoms, is crucial. I also propose that systematic check-ups be routinely carried out among athletes beyond their RTS medical clearance. Many athletes are highly motivated to return to competition, which may dissuade them from accurately reporting their lingering symptoms[150]. Based on various studies showing a relationship between cumulative concussions and poor outcomes[166-168], alongside other research indicating that the majority of athletes tracked until RTS appear to fully recover[157], I argue that the discrepancy may arise for two key reasons. First, athletes in these studies are constantly monitored and receive ongoing care, which may exert a placebo effect over and above the effects of treatment, influencing their symptom reporting and perceptions of recovery. Second, the intense desire to compete again can lead athletes to downplay even mild or lingering symptoms in order to resume their athletic activities. Therefore, ongoing monitoring and check-ups beyond RTS by team physicians could facilitate the identifying and addressing of symptoms that may arise after what initially appears to be complete recovery.

Study III

In Study III, we found that nearly 12% of elite ice hockey players competing in the SHL and HA endorsed moderate-risk or problem gambling behavior, while this pronounced level of gambling symptom burden was nearly absent among their female counterparts competing in the SWHL. This elevated prevalence was estimated to be nearly four times higher than that seen from young men in the general population. Among the male athletes, problem gambling symptom burden

was positively correlated with symptoms of depression and anxiety, as well as alcohol consumption.

These findings align with previous research indicating that symptoms of problem gambling are disproportionately prevalent among male elite ice hockey players[43-44], a trend not observed among their female counterparts. The heightened vulnerability among male athletes may be attributable to several factors, including differences in financial stability, personality traits, and greater exposure to, and more favorable attitudes toward, gambling within elite sport, particularly ice hockey[20-24].

First, elite athletes typically earn higher salaries during a shorter period of time than non-athletes in other professions[20], which may provide them with surplus funds that facilitate riskier gambling behaviors. In contrast, female athletes, who often earn less, may have less disposable income for high-stakes wagering[192]. This economic advantage can enable male athletes to wager increasingly larger sums, potentially leading to a pattern of tolerance development and over-indebtedness. Moreover, the availability of excess funds may delay the recognition of problematic gambling behaviors, thereby contributing to elevated psychological distress. Second, the typical psychological profile of athletes may also play a role. Athletes are generally more prone to sensation-seeking and risk-taking behaviors[22], a predisposition that can extend to gambling activities. Their heightened levels of perceived self-efficacy[24] may inflate their confidence in succeeding in largely chance-based gambling, while their perfectionistic tendencies[22] may predispose them to chase losses—a behavior commonly associated with gambling disorder[9]. Finally, athletes may exhibit more favorable attitudes toward gambling than non-athletes, a phenomenon potentially reinforced by the cultural integration of gambling within the sporting environment. This is particularly evident in Sweden, where a government-owned gambling operator acts as a primary sponsor for ice hockey leagues. Participants in Study IV noted that representatives from these gambling organizations maintain close ties with players through annual meetings, during which topics such as the rules governing betting on personal matches and the availability of support for gambling-related problems are discussed.

In addition to the adverse consequences associated with problem gambling, the concomitant symptoms of depression and anxiety underscore the imperative to address these issues within elite sports, particularly among male ice hockey athletes. Comprehensive psychoeducation programs should be implemented, and clear, accessible treatment pathways must be established. Although Study IV indicates a reduction in the stigma surrounding mental health within ice hockey, it remains uncertain whether this cultural shift translates into more help-seeking behavior for issues like gambling disorder. Therefore, targeted efforts are necessary to reshape attitudes toward obtaining mental health support[79]. Furthermore, providers of these mental health resources should operate independently of gambling-related

organizations to avoid potential conflicts of interest and to prevent the inadvertent reinforcement of favorable attitudes toward gambling. Preventive initiatives should also extend to younger age groups, who may be especially vulnerable to developing problem gambling behaviors through early exposure to these practices.

Drawing on the frameworks of the TPB[63,65] and the TTI[67], intentions to seek treatment are theoretically contingent on individuals' perceived self-efficacy[25], subjective norms, and affective attitudes toward help-seeking. Although athletes generally exhibit heightened levels of perceived self-efficacy and behavioral control[24], these advantages may be context-specific and may not extend to situations involving treatment-seeking. Notably, the adverse effects of mental health issues on self-esteem and subsequent self-efficacy may contribute significantly to the reluctance to seek help observed in these populations. Both informal and institutional support networks can play important roles in recognizing those in need and encouraging them to seek help. This can only be accomplished once a psychologically safe environment that enables effective communication surrounding mental health has been established. Thereafter, incorporating routine periodic screenings can aid in identifying those in need of assistance and providing them with the appropriate resources. Furthermore, interventions aimed at modifying social normative beliefs may help close the treatment gap. Presenting accurate data on the prevalence of gambling problems among these athletes can serve to destigmatize the issue and alleviate feelings of isolation. Finally, providing athletes with a balanced and evidence-based overview of the benefits and risks associated with help-seeking is likely to foster more positive attitudes toward treatment.

Study IV

In study IV, we found that the majority of patients who sought care at the Malmö Outpatient Psychiatric Clinic for Elite Sport and Health were female and active athletes from a diverse range of sports, with females seeking care earlier than their male counterparts. As expected, depressive, anxiety, and eating disorders were common, though there was a diverse range of disorders and symptoms that patients sought care for through the clinic[198], with the exception of substance use and addictive disorders.

During our interviews, participants described vastly heterogeneous experiences in terms of symptom development and presentation. Many described various intrinsic, extrinsic, sports culture-related factors that shaped how these issues manifested into adverse mental health symptoms[22,26-27,38-39]. Some issues were directly related to the demands of an elite athlete career, such as recurring concussions and rising demands from coaches and sponsors, but not all athletes attributed their struggles to sports-related roots (e.g., life circumstances, work-life balance)[115]. Using an ecological model, such as Team Denmark's[60], we can follow how the effects of external stressors from within Swedish society and culture can evoke downstream mental

health issues at the level of the individual. For example, several participants described moving from home as a perpetuating factor. Although not exclusive to elite-aspiring athletes, the relative age at which elite-aspiring youth athletes move from home to pursue an elite sporting career may occur at an earlier age. This change in environment and sudden requirement to take on more responsibility, on top of training to reach the next level, may be difficult for many to acclimate to if adequate support structures are not put in place for the young athlete. Meanwhile, embedded sports culture and expectations placed on the athlete from leadership that interact with underlying psychological traits, such as a predilection for perfectionism, may engender mental health issues that permeate into surrounding ecological layers. This highlights the need for interventions that acknowledge the layering and building up of these issues to ensure healthy training environments and balanced lifestyles.

Patients reported navigating complex, often convoluted pathways before ultimately accessing the specialized care they sought[79]. Prior to attending a specialist clinic, many initially sought treatment at traditional health clinics, where their experiences were mixed. This pattern is unsurprising, as those who eventually reached the specialist clinic were frequently dissatisfied with their prior care or reluctant to use conventional services for various psychosocial reasons. High-profile patients, in particular, expressed concerns about being recognized in traditional care settings, whereas lower-profile individuals more commonly encountered difficulties in finding therapists who understood their unique challenges[115]. Both groups underscored the importance of seeking help through non-traditional channels, though for distinct reasons: high-profile patients valued privacy, while lower-profile patients questioned the capacity of therapists lacking sports-specific expertise. These findings align with the frameworks of the TPB[63,65] and the TTI[67], which assert that attitudes toward treatment-seeking are shaped by the perceived benefits and risks. Many athletes feared that being identified as having mental health issues could adversely affect not only their competitive performance but also their professional value—potentially impacting contractual negotiations in a manner similar to how being labeled as injury-prone can lead to less favorable contractual outcomes. On the other hand, those that did not trust that therapists without sporting knowledge may have perceived the treatment with these professional to be fruitless, or that the benefits of seeking help would be minimal.

Some patients were uncertain whether their issues warranted clinical intervention, until they did think they needed to seek care, during which they were unsure where to go[79]. These processes can be temporally conceptualized through the transtheoretical model of change[55], in which individuals may oscillate among the precontemplation, contemplation, and preparation stages. In the precontemplation stage, patients may not fully recognize their problems, while in the contemplation and preparation stages, uncertainty about where to seek help persists. Without adequate resources and information[79], progression to the preparation and action

stages necessary for treatment seeking is hampered. Even among those who had initiated the preparation and action phases, systemic barriers ranging from identifying appropriate healthcare clinics and verifying treatment eligibility to obtaining referrals and scheduling appointments often resulted in an inability to complete the care process, ultimately reverting many patients to the precontemplation stage. Our findings suggest that only a brief window exists when this population is both receptive and able to seek care, during which perceived accessibility and availability not only influence their choice of providers but also determine whether they ultimately initiate treatment.

Based on these experiences, there is a clear need to reduce the administrative and procedural obstacles that prospective patients face when seeking mental health care. Although Sweden has introduced various digitalization strategies to mitigate these barriers, further improvements remain necessary. The high rate of self-referrals to the specialist clinic suggests that expanding the option of self-referral across additional mental health care settings may enhance accessibility for treatment-seeking individuals. From the perspectives of the TBP[63,65] and the TTI[67], reducing such obstacles could bolster perceived self-efficacy by alleviating the associated anxiety and risk of taking action. Moreover, according to SDT[69], minimizing these barriers may facilitate a return to self-actualization, thereby boosting self-esteem and mitigating adverse symptoms. As discussed in the original manuscript, integrating a designated mental health professional within the sporting environment may effectively bridge the divide between the sporting and non-sporting contexts. Our interview data indicate that most individuals who sought care had no prior experience independently accessing mental health services, underscoring the potential benefits of this embedded resource in facilitating initial help-seeking.

Participants consistently reported high satisfaction with the care received at sports-specialized clinics, attributing this mostly to a robust patient-clinician alliance enhanced by the clinicians' understanding of the sporting context[115]. Many athletes approached treatment with the same systematic rigor and diligence that characterizes their sports training, favoring intensive strategies designed to both improve and accelerate recovery outcomes[22,24]. However, challenges emerged regarding the limited availability of therapists, with participants expressing a strong desire for greater scheduling flexibility. While some acknowledged that their structured, training-oriented mindset might not always align with the inherently gradual nature of mental health care, this perspective underscores an important consideration for clinicians[78]. It is imperative that the treatment schedule, pace, and overall trajectory be clearly communicated and tailored from the start, allowing patients to adjust their expectations accordingly. Furthermore, expanding the treatment center's capacity to offer more frequent and extended sessions may be beneficial, particularly for treatment-resistant cases where sports-specific insights are especially valuable. Finally, clear guidance on how to access the clinic is

essential. Several participants reported encountering technological and other logistical barriers when attempting to initiate contact—often via digital platforms such as the 1177 system—resulting in misdirected or ineffective help-seeking efforts. Enhancing the integration among healthcare providers within the 1177 system could ensure that care-seeking attempts are properly channeled.

Strengths and limitations

The collection of studies included in this thesis exhibits several strengths and limitations that should be considered when evaluating their overall contribution to the literature. A primary strength lies in the use of relatively large sample sizes compared to similar studies, which enhances the precision of our estimates and bolsters the generalizability of our findings. Furthermore, the integration of both quantitative and qualitative methodologies allowed us to assess average effects at the population level while simultaneously exploring the nuanced factors that underpin these relationships, thereby providing a more comprehensive understanding of the phenomena. However, the large sample sizes also necessitate a careful interpretation of *p*-values, which indicate the level of evidence rather than the magnitude of the effects; hence, we relied on effect sizes and confidence intervals to evaluate the strength of the associations. In terms of recruitment, the absence of random sampling introduces potential selection bias, as our sample may over-represent healthier and more engaged individuals, and in Studies II and III, the underrepresentation of international male participants may skew the results toward a predominantly Swedish sample. Additionally, the qualitative component in Study IV employed purposive sampling to maximize data variation, a non-random approach that may have introduced unknown biases. Study I's design, which did not utilize paired data, precluded the assessment of true within-subject changes between 2021 and 2022; instead, between-group measures were employed under the assumption of independence—a condition that was compromised and limits the utility of our obtained level of statistical significance. Self-report bias also presents a limitation, particularly regarding the accuracy of participants' recollections of concussive events, and the fixed order of survey items in Studies II and III may have induced a priming effect that potentially inflated observed relationships. Regarding the models generated to assess the effect of concussion history on mental health outcomes, other confounders may exist that were unaccounted for. For example, family history of psychiatric disorders may be a confounder of interest that ought to be controlled for when considering the effect of concussion on mental health outcomes. Not doing so may lead to spurious results. Lastly, our results may not be directly generalizable to elite sporting populations outside of Sweden due to cultural and contextual differences that affect the mental health landscape in Sweden versus

elsewhere. Despite these limitations, the strengths of our study design provide robust support for our conclusions while simultaneously highlighting important areas for caution and avenues for future research.

Conclusions

In summary, these studies illuminate the complex interplay between environmental stressors and mental health in elite sports. Study I demonstrated a modest decline in depressive symptoms following the easing of COVID-19 restrictions, with nuanced differences across sex and sport and persistent anxiety levels alongside increased career-related concerns. Study II revealed that while male elite ice hockey players generally reported better mental health, cumulative SRCs were strongly associated with elevated symptoms of depression, anxiety, and burnout, and female players experienced notably higher burnout and similarly strong associations with SRCs. Study III highlighted a disproportionately high prevalence of problem gambling among male athletes, closely linked to adverse mental health outcomes. Finally, Study IV underscored the challenges athletes and sports staff face that not only give rise to adverse mental health symptoms, but also inhibit them from accessing specialized mental health care despite high satisfaction with tailored services. Collectively, these findings emphasize the need for comprehensive, context-sensitive interventions that address both the immediate and long-term psychological demands inherent to elite sport.

Acknowledgements

It gives me great pleasure to acknowledge all the wonderful and influential people who have contributed to this work and my development. Without choosing favorites, I would like to express my deepest thanks to:

Mina handledare **Anders Håkansson**, **Emma Claesdotter-Knutsson** och **Göran Kenttä**. Er ovärderliga expertis, ert engagemang och er passion för forskning har inte bara öppnat dörrar till nya insikter, utan också gett mig möjlighet att växa både akademiskt och personligt. Genom era breda och mångsidiga kunskaper har ni visat mig hur man angriper komplexa problem ur flera olika perspektiv. Ert stöd och er vägledning har varit avgörande för att forma min förmåga att tänka kritiskt och kreativt, och jag är tacksam för att ha er som mina förebilder inom forskning.

My collaborators and colleagues from the Lund Brain Injury laboratory for Neurosurgical research (LUBIN) and the Lund Bioimaging Centre—**Niklas Marklund**, **Georgios Michalettos**, **Michael Gottschalk**, and **Irma Mahmutovic Persson**—for their invaluable guidance and patience with me in the lab and behind the camera.

My former and future supervisors—**Douglas Jorenby** from the University of Wisconsin Center for Tobacco Research and Intervention and **Tim Meier** from the Medical College of Wisconsin's Brain Injury Research Group—for their knowledge and openness to collaboration.

The entire clinical addiction research team at the Malmö Addiction Center—including **Mirjam Wolfschlag**, **Carla Martí Valls**, **Yassir Abdul Rahim**, **Merve Topcu Bulut**, and **Marianne Balem**, whose companionship and help have been a constant source of inspiration.

My statistics colleagues within the Medical Faculty, **Pär-Ola Bendahl**, **Aleksandra Turkiewicz**, **Anton Nilsson**, and **Sara Ekberg**—for trusting me as an instructor for their courses and fielding each and every one of my countless questions.

My dearest friends, classmates, and hockey teammates over the years—**Pip Howlett**, **Ata Erdogan**, **OG Sutton**, **Ilce Herrada**, **Rob Wilk**, **Natali Plazonić**, **Lisa Granath**, **Ida Wikholm**, **Elisa Wandinger**, **Jakob Sonesson**, **Max Wedjesjö**, and **Truls Wendt** to name a few—for making this experience all the more memorable.

My parents, **Amy Pasley** and **Kurt Andersson**, whose constant encouragement empowered me to follow my dreams and even move halfway across the world in pursuit of them.

My siblings, **Kadin**, **Sophie**, **Davids**, and **Megi**¸ my father, **Sigits**, and the rest of my Midwest family, for their unwavering love and support from afar.

Family members who are no longer with us—my late brother, **Jesse**, and grandmother, **Doreen**, who I miss deeply and know would be proud of this work.

My dearest cousins, uncles, and aunts from Uppsala—for giving me a place to call home away from home.

Lastly, my darling wife-to-be, **Sanna Treptow**, for putting up with my antics, constantly showering me with affection and support since the day we met, and for choosing the color palette for my figures.

References

1. Poucher, Z. A., Tamminen, K. A., Kerr, G., & Cairney, J. (2021). A commentary on mental health research in elite sport. *Journal of Applied Sport Psychology, 33*(1), 60-82. https://doi.org/10.1080/10413200.2019.1668496
2. Schinke, R. J., Henriksen, K., Moore, Z. E., Stambulova, N., Bartley, J., Cosh, S., Wagstaff, C. R. D., Quartiroli, A., Wylleman, P., Maher, C. A., Zhang, L., Si, G., Kenttä, G., Zhang, C., Li, Y., Küttel, A., Brandao, R., & Wong, R. (2024). International society of sport psychology position stand: elite athlete mental health revisited. *International Journal of Sport and Exercise Psychology, 22*(4), 775-801. https://doi.org/10.1080/1612197X.2024.2359872
3. Wren-Lewis, S., & Alexandrova, A. (2021, December). *Mental health without well-being*. In The Journal of Medicine and Philosophy: A Forum for Bioethics and Philosophy of Medicine (Vol. 46, No. 6, pp. 684-703). US: Oxford University Press. https://doi.org/10.1093/jmp/jhab032
4. World Health Organization (2022a). Mental health. Retrieved 25 February 2025 from https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response
5. World Health Organization (2022b). Mental disorders. Retrieved 25 February 2025 from https://www.who.int/news-room/fact-sheets/detail/mental-disorders
6. American Psychological Association (2018a). Mental health. Retrieved 25 February 2025 from https://dictionary.apa.org/mental-health
7. American Psychological Association (2018b). Mental disorder. Retrieved 25 February 2025 from https://dictionary.apa.org/mental-disorder
8. American Psychiatric Association (2022). What is mental illness? Retrieved 25 February 2025 from https://www.psychiatry.org/patients-families/what-is-mental-illness#:~:text=Mental%20health%20is%20the%20foundation,component%20of%20overall%20well%2Dbeing.
9. American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders* (5th ed., text rev.). https://doi.org/10.1176/appi.books.9780890425787
10. World Health Organization. (2022). ICD-11: International classification of diseases (11th revision). https://icd.who.int/
11. Olsson, S., Hensing, G., Burström, B., & Löve, J. (2021). Unmet need for mental healthcare in a population sample in Sweden: a cross-sectional study of inequalities based on gender, education, and country of birth. *Community mental health journal, 57*(3), 470-481. https://doi.org/10.1007/s10597-020-00668-7
12. Rommel, A., Bretschneider, J., Kroll, L. E., Prütz, F., & Thom, J. (2017). The utilization of psychiatric and psychotherapeutic services in Germany–individual determinants and regional differences. *Journal of health monitoring, 2*(4), 3. https://doi.org/10.17886/RKI-GBE-2017-122.2
13. Clark, L. A., Cuthbert, B., Lewis-Fernández, R., Narrow, W. E., & Reed, G. M. (2017). Three approaches to understanding and classifying mental disorder: ICD-11, DSM-5, and the National Institute of Mental Health's Research Domain Criteria (RDoC). *Psychological Science in the Public Interest, 18*(2), 72-145. https://doi.org/10.1177/1529100617727266

14. Kotov, R., Cicero, D. C., Conway, C. C., DeYoung, C. G., Dombrovski, A., Eaton, N. R., First, M. B., Forbes, M. K., Hyman, S. E., Jonas, K. G., Krueger, R. F., Latzman, R. D., Li, J. J., Nelson, B. D., Regier, D. A., Rodriguez-Seijas, C., Ruggero, C. J., Simms, L. J., Skodol, A. E., … Wright, A. G. (2022). The Hierarchical Taxonomy of Psychopathology (HiTOP) in psychiatric practice and research. *Psychological medicine, 52*(9), 1666-1678. https://doi.org/10.1017/S0033291722001301
15. Breedvelt, J. J., Zamperoni, V., South, E., Uphoff, E. P., Gilbody, S., Bockting, C. L., Churchill, R., & Kousoulis, A. A. (2020). A systematic review of mental health measurement scales for evaluating the effects of mental health prevention interventions. *European Journal of Public Health, 30*(3), 510-516. https://doi.org/10.1093/eurpub/ckz233
16. McKinney, J., Velghe, J., Fee, J., Isserow, S., & Drezner, J. A. (2019). Defining athletes and exercisers. *The American journal of cardiology, 123*(3), 532-535. https://doi.org/10.1016/j.amjcard.2018.11.001
17. Swann, C., Moran, A., & Piggott, D. (2015). Defining elite athletes: Issues in the study of expert performance in sport psychology. *Psychology of sport and exercise, 16*, 3-14. https://doi.org/10.1016/j.psychsport.2014.07.004
18. Degens, H., Stasiulis, A., Skurvydas, A., Statkeviciene, B., & Venckunas, T. (2019). Physiological comparison between non-athletes, endurance, power and team athletes. *European journal of applied physiology, 119*, 1377-1386. https://doi.org/10.1007/s00421-019-04128-3
19. Furrer, R., Hawley, J. A., & Handschin, C. (2023). The molecular athlete: exercise physiology from mechanisms to medals. *Physiological reviews*. *103*(3), 1693-1787. https://doi.org/10.1152/physrev.00017.2022
20. Fox, G., West, J., & Drew, M. (2012). Wealth portfolios and elite professional athletes. *Journal of Financial Services Marketing, 17*, 273-283. https://doi.org/10.1057/fsm.2012.21
21. Moolman, J. (2022). Proposing a network of advisors that could guide a professional athlete's financial decisions in pursuit of sustainable financial well-being. *Managing Sport and Leisure, 27*(6), 577-592. https://doi.org/10.1080/23750472.2020.1842791
22. Chang, C. J., Putukian, M., Aerni, G., Diamond, A. B., Hong, E. S., Ingram, Y. M., Reardon, C. L., & Wolanin, A. T. (2020). Mental health issues and psychological factors in athletes: detection, management, effect on performance, and prevention: American medical society for sports medicine position statement. *Clinical Journal of Sport Medicine, 30*(2), e61-e87. https://doi.org/10.1097/JSM.0000000000000817
23. Steca, P., Baretta, D., Greco, A., D'Addario, M., & Monzani, D. (2018). Associations between personality, sports participation and athletic success. A comparison of Big Five in sporting and non-sporting adults. *Personality and Individual Differences, 121*, 176-183. https://doi.org/10.1016/j.paid.2017.09.040
24. Mitić, P., Nedeljković, J., Bojanić, Ž., Franceško, M., Milovanović, I., Bianco, A., & Drid, P. (2021). Differences in the psychological profiles of elite and non-elite athletes. *Frontiers in psychology, 12*, 635651. https://doi.org/10.3389/fpsyg.2021.635651
25. Bandura, A. (1997). *Self-efficacy: The exercise of control.* W H Freeman/Times Books/ Henry Holt & Co.
26. Arnold, R., & Fletcher, D. (2012). A research synthesis and taxonomic classification of the organizational stressors encountered by sport performers. *Journal of sport and exercise psychology, 34*(3), 397-429. https://doi.org/10.1123/jsep.34.3.397
27. Arnold, R., Fletcher, D., & Daniels, K. (2017). Organisational stressors, coping, and outcomes in competitive sport. *Journal of sports sciences, 35*(7), 694-703. https://doi.org/10.1080/02640414.2016.1184299

28. Hill, A. P., Hall, H. K., & Appleton, P. R. (2010). Perfectionism and athlete burnout in junior elite athletes: The mediating role of coping tendencies. *Anxiety, Stress, & Coping, 23*(4), 415-430. https://doi.org/10.1080/10615800903330966
29. Nuetzel, B. (2023). Coping strategies for handling stress and providing mental health in elite athletes: a systematic review. *Frontiers in Sports and Active Living, 5*, 1265783. https://doi.org/10.3389/fspor.2023.1265783
30. Rice, S. M., Purcell, R., De Silva, S., Mawren, D., McGorry, P. D., & Parker, A. G. (2016). The mental health of elite athletes: A narrative systematic review. *Sports medicine, 46*, 1333-1353. https://doi.org/10.1007/s40279-016-0492-2
31. Pluhar, E., McCracken, C., Griffith, K. L., Christino, M. A., Sugimoto, D., & Meehan III, W. P. (2019). Team sport athletes may be less likely to suffer anxiety or depression than individual sport athletes. *Journal of sports science & medicine, 18*(3), 490.
32. Jewett, R., Kerr, G., & Tamminen, K. (2019). University sport retirement and athlete mental health: A narrative analysis. *Qualitative Research in Sport, Exercise and Health, 11*(3), 416-433. https://doi.org/10.1080/2159676X.2018.1506497
33. Global Burden of Disease Collaborative Network. *Global Burden of Disease Study 2021* (GBD 2021). Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2024
34. Dragioti, E., Radua, J., Solmi, M., Arango, C., Oliver, D., Cortese, S., Jones, P. B., Shin, J. I., Correll, C. U., & Fusar-Poli, P. (2022). Global population attributable fraction of potentially modifiable risk factors for mental disorders: a meta-umbrella systematic review. *Molecular Psychiatry, 27*(8), 3510-3519. https://doi.org/10.1038/s41380-022-01586-8
35. Johansson, R., Carlbring, P., Heedman, Å., Paxling, B., & Andersson, G. (2013). Depression, anxiety and their comorbidity in the Swedish general population: point prevalence and the effect on health-related quality of life. *PeerJ, 1*, e98. https://doi.org/10.7717/peerj.98
36. Swedish Ministry of Health (2024. Nationella folkhälsoenkäten ”Hälsa på lika villkor?” Retrieved 25 February from https://www.folkhalsomyndigheten.se/folkhalsorapportering-statistik/om-vara-datainsamlingar/nationella-folkhalsoenkaten/#:~:text=Nationella%20folkh%C3%A4lsoenk%C3%A4ten%20i%20korthet&text=I%202024%20%C3%A5rs%20unders%C3%B6kning%20var,Fr%C3%A5geformul%C3%A4ret%20omfattade%2059%20fr%C3%A5gor%202024.
37. Gouttebarge, V., Castaldelli-Maia, J. M., Gorczynski, P., Hainline, B., Hitchcock, M. E., Kerkhoffs, G. M., Rice, S. M., & Reardon, C. L. (2019). Occurrence of mental health symptoms and disorders in current and former elite athletes: a systematic review and meta-analysis. *British journal of sports medicine, 53*(11), 700-706. https://doi.org/10.1136/bjsports-2019-100671
38. Reardon, C. L., Hainline, B., Aron, C. M., Baron, D., Baum, A. L., Bindra, A., Budgett, R., Campriani, N., Castaldelli-Maia, J. M., Currie, A., Derevensky, J. L., Glick, I. D., Gorczynski, P., Gouttebarge, V., Grandner, M. A., Han, D. H., McDuff, D., Mountjoy, M., Polat, A., … Engebretsen, L. (2019). Mental health in elite athletes: International Olympic Committee consensus statement (2019). *British journal of sports medicine, 53*(11), 667-699. https://doi.org/10.1136/bjsports-2019-100715
39. Rice, S. M., Gwyther, K., Santesteban-Echarri, O., Baron, D., Gorczynski, P., Gouttebarge, V., Reardon, C. L., Hitchcock, M. E., Hainline, B., & Purcell, R. (2019). Determinants of anxiety in elite athletes: a systematic review and meta-analysis. *British journal of sports medicine, 53*(11), 722-730. https://doi.org/10.1136/bjsports-2019-100620
40. Åkesdotter, C., Kenttä, G., Eloranta, S., & Franck, J. (2020). The prevalence of mental health problems in elite athletes. *Journal of science and medicine in sport, 23*(4), 329-335. https://doi.org/10.1016/j.jsams.2019.10.022

41. Poucher, Z. A., Tamminen, K. A., Sabiston, C. M., Cairney, J., & Kerr, G. (2021b). Prevalence of symptoms of common mental disorders among elite Canadian athletes. *Psychology of Sport and Exercise, 57*, 102018. https://doi.org/10.1016/j.psychsport.2021.102018
42. Fatt, S. J., George, E., Hay, P., Jeacocke, N., Gotkiewicz, E., & Mitchison, D. (2024). An umbrella review of body image concerns, disordered eating, and eating disorders in elite athletes. *Journal of Clinical Medicine, 13*(14), 4171. https://doi.org/10.3390/jcm13144171
43. Håkansson, A., Durand-Bush, N., & Kenttä, G. (2021). Problem gambling and problem gaming in elite athletes: A literature review. *International Journal of Mental Health and Addiction*, 1-17. https://doi.org/10.1007/s11469-021-00692-y
44. Vinberg, M., Durbeej, N., & Rosendahl, I. (2020). Gambling and gambling problem among elite athletes and their professional coaches: Findings from a Swedish total population survey of participants in four sports. *International Gambling Studies, 20*(2), 262-281. https://doi.org/10.1080/14459795.2020.1726990
45. Richter, D., & Dixon, J. (2023). Models of mental health problems: a quasi-systematic review of theoretical approaches. *Journal of Mental Health, 32*(2), 396-406. https://doi.org/10.1080/09638237.2021.2022638
46. Walsh, R. T., Teo, T., & Baydala, A. (2014). *A critical history and philosophy of psychology: Diversity of context, thought, and practice*. Cambridge University Press.
47. Shorter, E. (1997). *A history of psychiatry: From the era of the asylum to the age of Prozac.* John Wiley & Sons.
48. Nathan, P. E., Conrad, M., & Skinstad, A. H. (2016). History of the Concept of Addiction. *Annual review of clinical psychology, 12*(1), 29-51. https://doi.org/10.1146/annurev-clinpsy-021815-093546
49. Heilig, M., MacKillop, J., Martinez, D., Rehm, J., Leggio, L., & Vanderschuren, L. J. (2021). Addiction as a brain disease revised: why it still matters, and the need for consilience. *Neuropsychopharmacology, 46*(10), 1715-1723. https://doi.org/10.1038/s41386-020-00950-y
50. Koob, G. F., & Volkow, N. D. (2016). Neurobiology of addiction: a neurocircuitry analysis. *The lancet psychiatry, 3*(8), 760-773. https://doi.org/10.1016/S2215-0366(16)00104-8
51. Volkow, N. D., Koob, G. F., & McLellan, A. T. (2022). Neurobiologic advances from the brain disease model of addiction. *Evaluating the Brain Disease Model of Addiction*, 25-34.
52. Heyman, G. M. (2013). Addiction and choice: theory and new data. *Frontiers in psychiatry, 4*, 31. https://doi.org/10.3389/fpsyt.2013.00031
53. Lewis, M. (2017). Addiction and the brain: development, not disease. *Neuroethics, 10*(1), 7-18. https://doi.org/10.1007/s12152-016-9293-4
54. Peele, S. (2016). People control their addictions: No matter how much the "chronic" brain disease model of addiction indicates otherwise, we know that people can quit addictions–with special reference to harm reduction and mindfulness. *Addictive behaviors reports, 4*, 97-101. https://doi.org/10.1016/j.abrep.2016.05.003
55. Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. American journal of health promotion, 12(1), 38-48. https://doi.org/10.4278/0890-1171-12.1.38
56. Lundqvist, C., & Andersson, G. (2021). Let's talk about mental health and mental disorders in elite sports: a narrative review of theoretical perspectives. *Frontiers in psychology, 12*, 700829. https://doi.org/10.3389/fpsyg.2021.700829
57. Uphill, M., Sly, D., & Swain, J. (2016). From mental health to mental wealth in athletes: Looking back and moving forward. *Frontiers in psychology, 7*, 935. https://doi.org/10.3389/fpsyg.2016.00935
58. Küttel, A., Durand-Bush, N., & Larsen, C. H. (2021). Mental health profiles of Danish youth soccer players: the influence of gender and career development. *Journal of Clinical Sport Psychology, 16*(3), 276-293. https://doi.org/10.1123/jcsp.2021-0035

59. Stevens, M., Cruwys, T., Olive, L., & Rice, S. (2024). Understanding and improving athlete mental health: A social identity approach. *Sports Medicine, 54*(4), 837-853. https://doi.org/10.1007/s40279-024-01996-4
60. Henriksen, K., Diment, G., & Küttel, A. (2024). The Team Denmark applied model of athlete mental health. *International Journal of Sport and Exercise Psychology, 22*(9), 2325-2341. https://doi.org/10.1080/1612197X.2023.2281525
61. Gustafsson, H., Kenttä, G., & Hassmén, P. (2011). Athlete burnout: An integrated model and future research directions. *International Review of Sport and Exercise Psychology, 4*(1), 3-24. https://doi.org/10.1080/1750984X.2010.541927
62. Petrie, T. A., & Greenleaf, C. A. (2007). Eating disorders in sport: From theory to research to intervention. Handbook of sport psychology, 352-378. https//doi.org/10.1002/9781118270011
63. Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control: From cognition to behavior* (pp. 11-39). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-69746-3_2
64. Fishbein, M. & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley
65. Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. *Journal of applied social psychology, 32*(4), 665-683. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x
66. Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review, 84*(2), 191. https://psycnet.apa.org/doi/10.1037/0033-295X.84.2.191
67. Flay, B. R., & Petraitis, J. (1994). A new theory of health behavior with implications for preventive interventions. *Advances in medical sociology, 4*, 19-44.
68. Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. *Annual review of organizational psychology and organizational behavior*, *4*(1), 19-43. https://doi.org/10.1146/annurev-orgpsych-032516-113108
69. Deci, E. L., & Ryan, R. M. (2013). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media.
70. Habeeb, C., Warner, S., & Walsh, D. (2022). Managing mental health: Athlete help-seeking. *Sport Management Review, 25*(5), 871-891. https://doi.org/10.1080/14413523.2021.2018836
71. Bandelow, B., Werner, A. M., Kopp, I., Rudolf, S., Wiltink, J., & Beutel, M. E. (2022). The German Guidelines for the treatment of anxiety disorders: first revision. *European archives of psychiatry and clinical neuroscience, 272*(4), 571-582. https://doi.org/10.1007/s00406-021-01324-1
72. Kaczkurkin, A. N., & Foa, E. B. (2015). Cognitive-behavioral therapy for anxiety disorders: an update on the empirical evidence. *Dialogues in clinical neuroscience, 17*(3), 337-346. https://doi.org/10.31887/DCNS.2015.17.3/akaczkurkin
73. Cipriani, A., Furukawa, T. A., Salanti, G., Chaimani, A., Atkinson, L. Z., Ogawa, Y., Leucht, S., Ruhe, H. G., Turner, E. H., Higgins, J. P. T., Egger, M., Takeshima, N., Hayasaka, Y., Imai, H., Shinohara, K., Tajika, A., Ioannidis, J. P. A., & Geddes, J. R. (2018). Comparative efficacy and acceptability of 21 antidepressant drugs for the acute treatment of adults with major depressive disorder: a systematic review and network meta-analysis. *The Lancet, 391*(10128), 1357-1366. https://doi.org/10.1016/S0140-6736(17)32802-7
74. Cuijpers, P., Quero, S., Noma, H., Ciharova, M., Miguel, C., Karyotaki, E., Cipriani, A., Cristea, I. A., & Furukawa, T. A. (2021). Psychotherapies for depression: a network meta-analysis covering efficacy, acceptability and long-term outcomes of all main treatment types. *World Psychiatry, 20*(2), 283-293. https://doi.org/10.1002/wps.20860
75. Belay, G. M., Mak, Y. W., Wong, F. K. Y., Lam, K. K. W., Liu, Q., Yang, F., Mao, T., Wu, C. S. T., & Ho, K. Y. (2024). Psychosocial treatment options for adolescents and young adults with

alcohol use disorder: systematic review and meta-analysis. *Frontiers in public health, 12*, 1371497. https://doi.org/10.3389/fpubh.2024.1371497
76. Magill, M., Ray, L., Kiluk, B., Hoadley, A., Bernstein, M., Tonigan, J. S., & Carroll, K. (2019). A meta-analysis of cognitive-behavioral therapy for alcohol or other drug use disorders: Treatment efficacy by contrast condition. *Journal of consulting and clinical psychology, 87*(12), 1093. https://psycnet.apa.org/doi/10.1037/ccp0000447
77. McPheeters, M., O'Connor, E. A., Riley, S., Kennedy, S. M., Voisin, C., Kuznacic, K., Coffey, C. P., Edlund, M. D., Bobashev, G., & Jonas, D. E. (2023). Pharmacotherapy for alcohol use disorder: a systematic review and meta-analysis. *Jama, 330*(17), 1653-1665. https://doi.org/10.1001/jama.2023.19761
78. Stillman, M. A., Glick, I. D., McDuff, D., Reardon, C. L., Hitchcock, M. E., Fitch, V. M., & Hainline, B. (2019). Psychotherapy for mental health symptoms and disorders in elite athletes: a narrative review. *British journal of sports medicine, 53*(12), 767-771. https://doi.org/10.1136/bjsports-2019-100654
79. Cosh, S. M., McNeil, D. G., Jeffreys, A., Clark, L., & Tully, P. J. (2024). Athlete mental health help-seeking: a systematic review and meta-analysis of rates, barriers and facilitators. *Psychology of sport and exercise, 71*, 102586. https://doi.org/10.1016/j.psychsport.2023.102586
80. Ekelund, R., Holmström, S., & Stenling, A. (2022). Mental health in athletes: where are the treatment studies?. *Frontiers in psychology, 13*, 781177. https://doi.org/10.3389/fpsyg.2022.781177
81. Ekelund, R., Holmström, S., Gustafsson, H., Ivarsson, A., Lundqvist, C., & Stenling, A. (2023). Interventions for improving mental health in athletes: a scoping review. *International Review of Sport and Exercise Psychology*, 1-36. https://doi.org/10.1080/1750984X.2023.2258383
82. Wang, W., Schweickle, M. J., Arnold, E. R., & Vella, S. A. (2025). Psychological Interventions to Improve Elite Athlete Mental Wellbeing: A Systematic Review and Meta-analysis. *Sports Medicine*, 1-21. https://doi.org/10.1007/s40279-024-02173-3
83. Stillman, M. A., Manocchio, A. M., & Glick, I. D. (2023). Combining pharmacotherapy with psychotherapeutic management for the treatment of psychiatric disorders among athletes. *Sports Psychiatry*. https://doi.org/10.1024/2674-0052/a000056
84. World Health Organization (2020). Listings of WHO's response to COVID-19. Retrieved 20 February 2025 from https://www.who.int/news/item/29-06-2020-covidtimeline.
85. Swedish Civil Contingencies Agency (2020). The first confirmed coronavirus case in Sweden. Retrieved 20 February 2025 from https://www.krisinformation.se/en/news/2020/january/who-classes-the-outbreak-of-the-corona-virus-as-an-international-threat-to-human-life2.
86. World Health Organization (2023). Statement on the fifteenth meeting of the IHR (2005) Emergency Committee on the COVID-19 pandemic. Retrieved 20 February 2025 from https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic
87. World Health Organization (2025). WHO COVID-19 dashboard. Retrieved 20 February 2025 from https://data.who.int/dashboards/covid19/cases.
88. Lamers, M. M., & Haagmans, B. L. (2022). SARS-CoV-2 pathogenesis. *Nature reviews microbiology, 20*(5), 270-284. https://doi.org/10.1038/s41579-022-00713-0
89. Lemes, I. R., Smaira, F. I., Ribeiro, W. J., Favero, N. K., Matos, L. D. N. J., de Sá Pinto, A. L., Dolan, E., & Gualano, B. (2022). Acute and post-acute COVID-19 presentations in athletes: a systematic review and meta-analysis. *British journal of sports medicine, 56*(16), 941-947. https://doi.org/10.1136/bjsports-2022-105583
90. Berlin, D. A., Gulick, R. M., & Martinez, F. J. (2020). Severe covid-19. *New England Journal of Medicine, 383*(25), 2451-2460. https://doi.org/10.1056/NEJMcp2009575

91. Booth, A., Reed, A. B., Ponzo, S., Yassaee, A., Aral, M., Plans, D., Labrique, A., & Mohan, D. (2021). Population risk factors for severe disease and mortality in COVID-19: A global systematic review and meta-analysis. *PloS one, 16*(3), e0247461. https://doi.org/10.1371/journal.pone.0247461
92. Greenhalgh, T., Sivan, M., Perlowski, A., & Nikolich, J. Ž. (2024). Long COVID: a clinical update. *The Lancet, 404*(10453), 707-724. https://doi.org/10.1016/S0140-6736(24)01136-X
93. Ceban, F., Kulzhabayeva, D., Rodrigues, N. B., Di Vincenzo, J. D., Gill, H., Subramaniapillai, M., Lui, L. M.W., Cao, B., Mansur, R. B., Ho, R. C., Burke, M. J., Rhee, T. G., Rosenblat, J. D., & McIntyre, R. S. (2023). COVID-19 vaccination for the prevention and treatment of long COVID: A systematic review and meta-analysis. *Brain, behavior, and immunity, 111*, 211-229. https://doi.org/10.1016/j.bbi.2023.03.022
94. Tsampasian, V., Elghazaly, H., Chattopadhyay, R., Debski, M., Naing, T. K. P., Garg, P., ... & Vassiliou, V. S. (2023). Risk factors associated with post− COVID-19 condition: a systematic review and meta-analysis. *JAMA internal medicine*, *183*(6), 566-580. https://doi.org/10.1001/jamainternmed.2023.0750
95. Seo, J. W., Kim, S. E., Kim, Y., Kim, E. J., Kim, T., Kim, T., Lee, S. H., Lee, E., Lee, J., Seo, Y. B., Jeon, Y., Jung, Y. H., Choi, Y. J., & Song, J. Y. (2024). Updated Clinical Practice Guidelines for the Diagnosis and Management of Long COVID. *Infection & chemotherapy, 56*(1), 122. https://doi.org/10.3947/ic.2024.0024
96. Brusselaers, N., Steadson, D., Bjorklund, K., Breland, S., Stilhoff Sörensen, J., Ewing, A., Bergmann, S., & Steineck, G. (2022). Evaluation of science advice during the COVID-19 pandemic in Sweden. *Humanities and Social Sciences Communications, 9*(1). https://doi.org/10.1057/s41599-022-01097-5
97. Cheng, C., Barceló, J., Hartnett, A. S., Kubinec, R., & Messerschmidt, L. (2020). COVID-19 government response event dataset (CoronaNet v. 1.0). *Nature human behaviour, 4*(7), 756-768. https://doi.org/10.1038/s41562-020-0909-7
98. Kavaliunas, A., Ocaya, P., Mumper, J., Lindfeldt, I., & Kyhlstedt, M. (2020). Swedish policy analysis for Covid-19. *Health Policy and Technology, 9*(4), 598-612. https://doi.org/10.1016/j.hlpt.2020.08.009
99. Lindström, M. (2021). The New Totalitarians: The Swedish COVID-19 strategy and the implications of consensus culture and media policy for public health. *SSM-Population Health, 14*, 100788. https://doi.org/10.1016/j.ssmph.2021.100788
100. Wang, J., Kaperak, C., Sato, T., & Sakuraba, A. (2021). COVID-19 reinfection: a rapid systematic review of case reports and case series. *Journal of Investigative Medicine, 69*(6), 1253-1255. https://doi.org/10.1136/jim-2021-001853
101. Nilson, F. (2021). A biased analysis of the Swedish management of Covid-19. *Health Policy and Technology, 10*(3), 100542. https://doi.org/10.1016/j.hlpt.2021.100542
102. Herby, J., Jonung, L., & Hanke, S. H. (2023). Did lockdowns work?: The verdict on Covid restrictions. *IEA Perspectives*, (1). Retrieved 20 February from https://iea.org.uk/publications/did-lockdowns-work-the-verdict-on-covid-restrictions/
103. Swedish Ministry of Health (2025). Bekräftade fall av covid-19 i Sverige. Retrieved 20 February 2025 from https://www.folkhalsomyndigheten.se/faktablad/fall-covid-19/.
104. Swedish Ministry of Health (2024). När hände vad under pandemin? Retrieved 20 February 2025 from https://www.folkhalsomyndigheten.se/smittskydd-beredskap/utbrott/utbrottsarkiv/covid-19-pandemin-2019-2023/nar-hande-vad-under-pandemin
105. Nordlund, F. (2021). Nästan en tredjedel har fått två doser vaccin. Retrieved 20 February from https://omni.se/nastan-en-tredjedel-har-fatt-tva-doser-vaccin/a/39rgKv

106. Hedenborg, S., Fredman, P., Hansen, A. S., & Wolf-Watz, D. (2024). Outdoorification of sports and recreation: a leisure transformation under the COVID-19 pandemic in Sweden. *Annals of Leisure Research, 27*(1), 36-54. https://doi.org/10.1080/11745398.2022.2101497
107. Josefsson, K. W. (2021). Perspectives of life in Sweden during the COVID-19 pandemic. *Journal of Clinical Sport Psychology, 15*(1), 80-86. https://doi.org/10.1123/jcsp.2020-0055
108. Swedish Sports Confederation (2021). Ett år med corona – maj 2021. Retrieved 20 February 2025 from https://www.rf.se/download/18.5424ab70183abb853551a42/1665068711964/Ett%20%C3%A5r%20med%20corona.pdf
109. Martínez-Patiño, M. J., Blas Lopez, F. J., Dubois, M., Vilain, E., & Fuentes-García, J. P. (2021). Effects of COVID-19 home confinement on behavior, perception of threat, stress and training patterns of olympic and paralympic athletes. *International journal of environmental research and public health, 18*(23), 12780. https://doi.org/10.3390/ijerph182312780
110. Håkansson, A., Fernández-Aranda, F., Menchón, J. M., Potenza, M. N., & Jiménez-Murcia, S. (2020). Gambling during the COVID-19 crisis–a cause for concern. *Journal of addiction medicine, 14*(4), e10-e12. https://doi.org/10.1097/ADM.0000000000000690
111. Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., & Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. *International journal of social psychiatry, 66*(4), 317-320. https://doi.org/10.1177/0020764020915212
112. Lok, V., Sjöqvist, H., Sidorchuk, A., Flodin, P., Osika, W., Daly, M., Hyland, M., Andersen, L. H., Fallesen, P., Cabrera, M. C., Knudsen, A.K.S., Wetherall, K., Widnall, E., Groarke, J. M., Armour, C., Dalman, C., Hollanders, A., & Niemi, M. (2023). Changes in anxiety and depression during the COVID-19 pandemic in the European population: A meta-analysis of changes and associations with restriction policies. *European Psychiatry, 66*(1), e87. https://doi.org/10.1192/j.eurpsy.2023.2467
113. Penninx, B. W., Benros, M. E., Klein, R. S., & Vinkers, C. H. (2022). How COVID-19 shaped mental health: from infection to pandemic effects. *Nature medicine, 28*(10), 2027-2037. https://doi.org/10.1038/s41591-022-02028-2
114. Robinson, E., Sutin, A. R., Daly, M., & Jones, A. (2022). A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. *Journal of affective disorders, 296*, 567-576. https://doi.org/10.1016/j.jad.2021.09.098
115. Åkesdotter, C., Kenttä, G., & Sparkes, A. C. (2024). Elite athletes seeking psychiatric treatment: Stigma, impression management strategies, and the dangers of the performance narrative. *Journal of Applied Sport Psychology, 36*(1), 24-44. https://doi.org/10.1080/10413200.2023.2185697
116. Håkansson, A., Moesch, K., Jönsson, C., & Kenttä, G. (2021). Potentially prolonged psychological distress from postponed olympic and paralympic games during COVID-19—career uncertainty in elite athletes. *International journal of environmental research and public health, 18*(1), 2. https://doi.org/10.3390/ijerph18010002
117. Mehrsafar, A. H., Gazerani, P., Zadeh, A. M., & Sánchez, J. C. J. (2020). Addressing potential impact of COVID-19 pandemic on physical and mental health of elite athletes. *Brain, behavior, and immunity, 87*, 147. https://doi.org/10.1016/j.bbi.2020.05.011
118. Reardon, C. L., Bindra, A., Blauwet, C., Budgett, R., Campriani, N., Currie, A., Gouttebarge, V., McDuff, D., Moutjoy, M., Purcell, R., Putukian, M., Rice, S., & Hainline, B. (2021). Mental health management of elite athletes during COVID-19: a narrative review and recommendations. *British journal of sports medicine, 55*(11), 608-615. https://doi.org/10.1136/bjsports-2020-102884

119. Ribeiro, J., Caldeira, D., & Dores, H. (2024). Long-term manifestations of COVID-19 in athletes: a narrative review. *The Physician and Sportsmedicine*, 1-8. https://doi.org/10.1080/00913847.2024.2321629
120. Wezenbeek, E., Denolf, S., Bourgois, J. G., Philippaerts, R. M., De Winne, B., Willems, T. M., Witvrouw, E., Verstockt, S., & Schuermans, J. (2023). Impact of (long) COVID on athletes' performance: a prospective study in elite football players. *Annals of Medicine, 55*(1), 2198776. https://doi.org/10.1080/07853890.2023.2198776
121. Jia, L., Carter, M. V., Cusano, A., Li, X., Kelly IV, J. D., Bartley, J. D., & Parisien, R. L. (2023). The effect of the COVID-19 pandemic on the mental and emotional health of athletes: a systematic review. *The American Journal of Sports Medicine, 51*(8), 2207-2215. https://doi.org/10.1177/03635465221087473
122. Dougall, D., Kelly, C., & Khwaja, M. (2012). Mental health service demand during the Summer Olympics: literature review. *The Psychiatrist, 36*(8), 303-306. https://doi.org/10.1192/pb.bp.112.038778
123. Nishida, M., Takagi, S., Yamaguchi, T., Yamamoto, H., Yoshino, S., Yagishita, K., & Akama, T. (2022). Mental health services at the Tokyo 2020 Olympic and Paralympic Games during the COVID-19 pandemic. *Sports Psychiatry*, *1*(2), 36-38. https://doi.org/10.1024/2674-0052/a000005
124. Håkansson, A., & Grudet, C. (2021). Decreasing psychiatric emergency visits, but stable addiction emergency visits, during COVID-19—a time series analysis 10 months into the pandemic. *Frontiers in psychiatry, 12*, 664204. https://doi.org/10.3389/fpsyt.2021.664204
125. TSN (2017). Paul Kariya - "Surfacing" - TSN Feature 2017 (HD). Retrieved 28 February 2025 from https://www.youtube.com/watch?v=ufb6Q-b-ZxI
126. ESPN (2011). Paul Kariya announces retirement. Retrieved 28 February 2025 from https://www.espn.com/nhl/news/story?id=6716981
127. Menon, D. K., Schwab, K., Wright, D. W., & Maas, A. I. (2010). Position statement: definition of traumatic brain injury. *Archives of physical medicine and rehabilitation, 91*(11), 1637-1640. https://doi.org/10.1016/j.apmr.2010.05.017
128. Malec, J. F., Brown, A. W., Leibson, C. L., Flaada, J. T., Mandrekar, J. N., Diehl, N. N., & Perkins, P. K. (2007). The mayo classification system for traumatic brain injury severity. *Journal of neurotrauma, 24*(9), 1417-1424. https://doi.org/10.1089/neu.2006.0245
129. Silverberg, N. D., Iverson, G. L., Cogan, A., Dams-O-Connor, K., Delmonico, R., Graf, M. J. P., Iaccarino, M. A., Kajankova, M., Kamins, J., McCulloch, K. L., McKinney, G., Nagele, D., Panenka, W. J., Rabinowitz, A. R., Reed, N., Wethe, J. V., Whitehair, V., Anderson, V., Arciniegas, D. B., . . . Zemek, R. (2023). The American Congress of Rehabilitation Medicine Diagnostic Criteria for Mild Traumatic Brain Injury. *Archives of Physical Medicine and Rehabilitation, 104*(8), 1343–1355. https://doi.org/10.1016/j.apmr.2023.03.036
130. Tabor, J. B., Brett, B. L., Nelson, L., Meier, T., Penner, L. C., Mayer, A. R., Echemendia, R. J., McAllister, T., Meehan III, W. P., Patricios, J., Makdissi, M., Bressan, Sl., Davis, G. A., Premji, Z., Schneider, K. J., Zetterberg, H., & McCrea, M. (2023). Role of biomarkers and emerging technologies in defining and assessing neurobiological recovery after sport-related concussion: a systematic review. *British journal of sports medicine, 57*(12), 789-797. https://doi.org/10.1136/bjsports-2022-106680
131. Craig, D.B., Beauchamp, K.M. (2012). Cerebral Concussion. In: Vincent, JL., Hall, J.B. (eds) *Encyclopedia of Intensive Care Medicine*. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-00418-6_386
132. Davis, G. A., Patricios, J., Schneider, K. J., Iverson, G. L., & Silverberg, N. D. (2023). Definition of sport-related concussion: the 6th International Conference on Concussion in Sport.

British journal of sports medicine, 57(11), 617-618. https://doi.org/10.1136/bjsports-2022-106650
133. Maas, A. I., Menon, D. K., Adelson, P. D., Andelic, N., Bell, M. J., Belli, A., Bragge, P., Brazinova, A., Büku, A., Chesnut, R. M., Citerio, G., Coburn, M., Cooper, D. J., Crowder, A. T., Czeiter, E., Czosnyka, M., Diaz-Arrastia, R., Dreier, J. P., Duhaime, A., ... Zumbo, F. (2017). Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. *The Lancet Neurology, 16*(12), 987-1048. https://doi.org/10.1016/S1474-4422(17)30371-X
134. Lefevre-Dognin, C., Cogné, M., Perdrieau, V., Granger, A., Heslot, C., & Azouvi, P. (2021). Definition and epidemiology of mild traumatic brain injury. *Neurochirurgie, 67*(3), 218-221. https://doi.org/10.1016/j.neuchi.2020.02.002
135. Corrigan, J. D., Yang, J., Singichetti, B., Manchester, K., & Bogner, J. (2018). Lifetime prevalence of traumatic brain injury with loss of consciousness. *Injury prevention, 24*(6), 396-404. https://doi.org/10.1136/injuryprev-2017-042371
136. Eggertsen, P. P., Cordsen, P., Lauritsen, J., Johnsen, S. P., & Nielsen, J. F. (2024). Incidence and prevalence of concussion in Denmark from 1999 to 2018: a nationwide cohort study. *Journal of Neurotrauma*. https://doi.org/10.1089/neu.2024.0217
137. Veliz, P., McCabe, S. E., Eckner, J. T., & Schulenberg, J. E. (2021). Trends in the prevalence of concussion reported by US adolescents, 2016-2020. *JAMA, 325*(17), 1789-1791. https://doi.org/10.1001/jama.2021.1538
138. Kroshus, E., Garnett, B., Hawrilenko, M., Baugh, C. M., & Calzo, J. P. (2015). Concussion under-reporting and pressure from coaches, teammates, fans, and parents. *Social science & medicine, 134*, 66-75. https://doi.org/10.1016/j.socscimed.2015.04.011
139. Glace, B. W., Kremenic, I. J., Hogan, D. E., & Kwiecien, S. Y. (2023). Incidence of concussions and helmet use in equestrians. *Journal of science and medicine in sport, 26*(2), 93-97. https://doi.org/10.1016/j.jsams.2022.12.004
140. Kerr, Z. Y., Chandran, A., Nedimyer, A. K., Arakkal, A., Pierpoint, L. A., & Zuckerman, S. L. (2019). Concussion incidence and trends in 20 high school sports. *Pediatrics, 144*(5). https://doi.org/10.1542/peds.2019-2180
141. Lystad, R. P., Alevras, A., Rudy, I., Soligard, T., & Engebretsen, L. (2021). Injury incidence, severity and profile in Olympic combat sports: a comparative analysis of 7712 athlete exposures from three consecutive Olympic Games. *British journal of sports medicine, 55*(19), 1077-1083.
142. West, S. W., Cross, M., Trewartha, G., Taylor, A., Brooks, J., Kemp, S., ... & Stokes, K. (2021). Trends in match concussion incidence and return-to-play time in male professional Rugby Union: A 16-season prospective cohort study. *Brain injury, 35*(10), 1235-1244. https://doi.org/10.1080/02699052.2021.1972142
143. Pavlovic, D., Pekic, S., Stojanovic, M., & Popovic, V. (2019). Traumatic brain injury: neuropathological, neurocognitive and neurobehavioral sequelae. *Pituitary, 22*, 270-282. https://doi.org/10.1007/s11102-019-00957-9
144. Giza, C. C., & Hovda, D. A. (2014). The new neurometabolic cascade of concussion. *Neurosurgery, 75*, S24-S33. https://doi.org/10.1227/NEU.0000000000000505
145. Pozo Devoto, V. M., Lacovich, V., Feole, M., Bhat, P., Chovan, J., Čarna, M., ... & Stokin, G. B. (2022). Unraveling axonal mechanisms of traumatic brain injury. *Acta neuropathologica communications, 10*(1), 140. https://doi.org/10.1186/s40478-022-01414-8
146. Reeves, T. M., Phillips, L. L., & Povlishock, J. T. (2005). Myelinated and unmyelinated axons of the corpus callosum differ in vulnerability and functional recovery following traumatic brain injury. *Experimental neurology, 196*(1), 126-137. https://doi.org/10.1016/j.expneurol.2005.07.014

147. Özen, I., Mai, H., De Maio, A., Ruscher, K., Michalettos, G., Clausen, F., F., Gottschalk, M., Ansar, S., Arkan, S., Erturk, A., & Marklund, N. (2022). Purkinje cell vulnerability induced by diffuse traumatic brain injury is linked to disruption of long-range neuronal circuits. *Acta neuropathologica communications, 10*(1), 129. https://doi.org/10.1186/s40478-022-01435-3
148. Meier, T. B., Bellgowan, P. S., Singh, R., Kuplicki, R., Polanski, D. W., & Mayer, A. R. (2015). Recovery of cerebral blood flow following sports-related concussion *JAMA neurology, 72*. (5), 530-538. https://doi.org/10.1001/jamaneurol.2014.4778
149. Rodney, T., Osier, N., & Gill, J. (2018). Pro-and anti-inflammatory biomarkers and traumatic brain injury outcomes: a review. *Cytokine, 110*, 248-256. https://doi.org/10.1016/j.cyto.2018.01.012
150. Asken, B. M., McCrea, M. A., Clugston, J. R., Snyder, A. R., Houck, Z. M., & Bauer, R. M. (2016). "Playing through it": delayed reporting and removal from athletic activity after concussion predicts prolonged recovery. *Journal of athletic training, 51*(4), 329-335. https://doi.org/10.4085/1062-6050-51.5.02
151. Echemendia, R. J., Brett, B. L., Broglio, S., Davis, G. A., Giza, C. C., Guskiewicz, K. M., Harmon, K. G., Herring, S., Howell, D. R., Master, C. L., McLeod, T. C. V., McCrea, M., Naidu, D., Patricios, J., Putukian, M., Walton, S. R., Schneider, K. J., Burma, J. S., & Bruce, J. M. (2023). Introducing the sport concussion assessment tool 6 (SCAT6). *British Journal of Sports Medicine, 57*(11), 619-621. https://doi.org/10.1136/bjsports-2023-106849
152. Hossain, I., Marklund, N., Czeiter, E., Hutchinson, P., & Buki, A. (2024). Blood biomarkers for traumatic brain injury: A narrative review of current evidence. *Brain and spine, 4*, 102735. https://doi.org/10.1016/j.bas.2023.102735
153. Caprelli, M. T., Mothe, A. J., & Tator, C. H. (2018). Hyperphosphorylated tau as a novel biomarker for traumatic axonal injury in the spinal cord. *Journal of Neurotrauma, 35*(16), 1929-1941. https://doi.org/10.1089/neu.2017.5495
154. Gard, A., Kornaropoulos, E. N., Wernersson, M. P., Rorsman, I., Blennow, K., Zetterberg, H., Tegner, Y., De Maio, A., Bloch, K. M., Björkman-Burtscher, I., Pessah-Rasmussen, H., Nilsson, M., & Marklund, N. (2024). Widespread White Matter Abnormalities in Concussed Athletes Detected by 7T Diffusion Magnetic Resonance Imaging. *Journal of Neurotrauma*, *41*(13-14), 1533-1549. https://doi.org/10.1089/neu.2023.0099
155. Wasserman, E. B., Kerr, Z. Y., Zuckerman, S. L., & Covassin, T. (2016). Epidemiology of sports-related concussions in National Collegiate Athletic Association athletes from 2009-2010 to 2013-2014: symptom prevalence, symptom resolution time, and return-to-play time. The *American journal of sports medicine, 44*(1), 226-233. https://doi.org/10.1177/0363546515610537
156. Kontos, A. P., Sufrinko, A., Sandel, N., Emami, K., & Collins, M. W. (2019). Sport-related concussion clinical profiles: clinical characteristics, targeted treatments, and preliminary evidence. *Current sports medicine reports, 18*(3), 82-92. https://doi.org/10.1249/JSR.0000000000000573
157. Broglio, S. P., McAllister, T., Katz, B. P., LaPradd, M., Zhou, W., & McCrea, M. A. (2022). The natural history of sport-related concussion in collegiate athletes: findings from the NCAA-DoD CARE Consortium. *Sports medicine, 52*(2), 403-415. https://doi.org/10.1007/s40279-021-01541-7
158. Patricios, J. S., Schneider, K. J., Dvorak, J., Ahmed, O. H., Blauwet, C., Cantu, R. C., Davis, G. A., Echemendia, R. J., Makdissi, M., McNamee, M., Broglio, S., Emery, C. A., Feddermann-Demont, N., Fuller, G. W., Giza, C. C., Guskiewicz, K. M., Hainline, B., Iverson, G. L., Kutcher, J. S., . . . Meeuwisse, W. (2023). Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport–Amsterdam, October 2022. *British journal of sports medicine, 57*(11), 695-711. https://doi.org/10.1136/bjsports-2023-106898

159. Leddy, J. J., Burma, J. S., Toomey, C. M., Hayden, A., Davis, G. A., Babl, F. E., Gagnon, I., Giza, C. C., Kurowski, B. G., Silverberg, N. D., Willer, B., Ronksley, P. E., & Schneider, K. J. (2023). Rest and exercise early after sport-related concussion: a systematic review and meta-analysis. British *journal of sports medicine, 57*(12), 762-770. https://doi.org/10.1136/bjsports-2022-106676
160. O'Connell, C. J., Brown, R. S., Peach, T. M., Traubert, O. D., Schwierling, H. C., Notorgiacomo, G. A., & Robson, M. J. (2024). Strain in the midbrain: impact of traumatic brain injury on the central serotonin system. *Brain Sciences, 14*(1), 51. https://doi.org/10.3390/brainsci14010051
161. Rabinowitz, A. R., & Watanabe, T. K. (2020). Pharmacotherapy for treatment of cognitive and neuropsychiatric symptoms after mTBI. *The Journal of head trauma rehabilitation, 35*(1), 76-83. https://doi.org/10.1097/HTR.0000000000000537
162. McAllister, T. W., Broglio, S. P., Katz, B. P., Perkins, S. M., LaPradd, M., Zhou, W., & Concussion Assessment, Research and Education (CARE) Consortium. (2023). Characteristics and outcomes of athletes with slow recovery from sports-related concussion: a CARE Consortium Study. *Neurology, 100*(14), e1510-e1519. https://doi.org/10.1212/WNL.0000000000206853
163. Cancelliere, C., Verville, L., Stubbs, J. L., Yu, H., Hincapié, C. A., Cassidy, J. D., Wong, J. J., Shearer, H. M., Connell, G., Southerst, D., Howitt, S., Guist, B., & Silverberg, N. D. (2023). Post-concussion symptoms and disability in adults with mild traumatic brain injury: a systematic review and meta-analysis. *Journal of neurotrauma, 40*(11-12), 1045-1059. https://doi.org/10.1089/neu.2022.0185
164. Silverberg, N. D., & Mikolić, A. (2023). Management of psychological complications following mild traumatic brain injury. *Current Neurology and Neuroscience Reports, 23*(3), 49-58. https://doi.org/10.1007/s11910-023-01251-9
165. Lambert, M., Sheldrake, E., Deneault, A. A., Wheeler, A., Burke, M., & Scratch, S. (2022). Depressive symptoms in individuals with persistent postconcussion symptoms: a systematic review and meta-analysis. *JAMA Network open*, *5*(12), e2248453-e2248453. https://doi.org/10.1001/jamanetworkopen.2022.48453
166. Manley, G., Gardner, A. J., Schneider, K. J., Guskiewicz, K. M., Bailes, J., Cantu, R. C., Castellani, R. J., Turner, M., Jordan, B. D., Randolph, C., Dvořák, J., Hayden, K. A., Tator, C. H., McCrory, P., & Iverson, G. L. (2017). A systematic review of potential long-term effects of sport-related concussion. *British journal of sports medicine, 51*(12), 969-977. https://doi.org/10.1136/bjsports-2017-097791
167. Brett, B. L., Kerr, Z. Y., Walton, S. R., Chandran, A., Defreese, J. D., Mannix, R., Echemendia, R. J., Meehan, W. P., Guskiewicz, K. M., & McCrea, M. (2021). Longitudinal trajectory of depression symptom severity and the influence of concussion history and physical function over a 19-year period among former National Football League (NFL) players: an NFL-LONG Study. *Journal of Neurology, Neurosurgery & Psychiatry, 93*(3), 272-279. https://doi.org/10.1136/jnnp-2021-326602
168. Brett, B. L., Sullivan, M. E., Asken, B. M., Terry, D. P., Meier, T. B., & McCrea, M. A. (2024). Long-term neurobehavioral and neuroimaging outcomes in athletes with prior concussion (s) and head impact exposure. *The Clinical Neuropsychologist*, 1-29. https://doi.org/10.1080/13854046.2024.2442427
169. Bloom, G. A., Trbovich, A. M., Caron, J. G., & Kontos, A. P. (2022). Psychological aspects of sport-related concussion: An evidence-based position paper. *Journal of Applied Sport Psychology, 34*(3), 495-517. https://doi.org/10.1080/10413200.2020.1843200
170. Iverson, G. L., Williams, M. W., Gardner, A. J., & Terry, D. P. (2020). Systematic review of preinjury mental health problems as a vulnerability factor for worse outcome after sport-related

concussion. *Orthopaedic journal of sports medicine, 8*(10). https://doi.org/10.1177/2325967120950682
171. Walton, S. R., Kerr, Z. Y., Brett, B. L., Chandran, A., DeFreese, J. D., Smith-Ryan, A. E., Stoner, L., Echemendia, R. J., McCrea, M., Meehan, W. P. III., & Guskiewicz, K. M. (2021). Health-promoting behaviours and concussion history are associated with cognitive function, mood-related symptoms and emotional–behavioural dyscontrol in former NFL players: an NFL-LONG Study. *British journal of sports medicine, 55*(12), 683-690. https://doi.org/10.1136/bjsports-2020-103400
172. Wingerson, M. J., Carry, P., Mannix, R., Meier, T., Smulligan, K. L., Wilson, J. C., & Howell, D. R. (2025). Concussion and depressive symptoms in high school students: impact of physical activity and substance use. *British Journal of Sports Medicine, 59*(4), 249-256. https://doi.org/10.1136/bjsports-2024-109029
173. Gard, A., Lehto, N., Engström, Å., Shahim, P., Zetterberg, H., Blennow, K., Marklund, N., & Tegner, Y. (2020). Quality of life of ice hockey players after retirement due to concussions. *Concussion, 5*(3), CNC78. https://doi.org/10.2217/cnc-2020-0007
174. Collict, C., Benson, A. J., Schaefer, L., & Caron, J. G. (2025). Exploring how athletes navigate identity-related changes following sport-related concussion. *Sport, Exercise, and Performance Psychology*. https://doi.org/10.1037/spy0000379
175. Iverson, G. L., Castellani, R. J., Cassidy, J. D., Schneider, G. M., Schneider, K. J., Echemendia, R. J., Bailes, J. E., Hayden, H. A., Koerte, I. K., Manley, G. T., McNamee, M., Patricios, J. S., Tator, C. H., Cantu, R. C., & Dvorak, J. (2023). Examining later-in-life health risks associated with sport-related concussion and repetitive head impacts: a systematic review of case-control and cohort studies. *British journal of sports medicine, 57*(12), 810-824. https://doi.org/10.1136/bjsports-2023-106890
176. Mackay, D. F., Russell, E. R., Stewart, K., MacLean, J. A., Pell, J. P., & Stewart, W. (2019). Neurodegenerative disease mortality among former professional soccer players. *New England Journal of Medicine, 381*(19), 1801-1808. https://doi.org/10.1056/NEJMoa1908483
177. Ueda, P., Pasternak, B., Lim, C. E., Neovius, M., Kader, M., Forssblad, M., Ludvigsson, J. F., & Svanström, H. (2023). Neurodegenerative disease among male elite football (soccer) players in Sweden: a cohort study. *The Lancet Public Health, 8*(4), e256-e265. https://doi.org/10.1016/S2468-2667(23)00027-0
178. Martland, H. S. (1928). Punch drunk. *Journal of the American Medical Association, 91*(15), 1103-1107. https://doi.org/10.1001/jama.1928.02700150029009
179. Omalu, B. I., DeKosky, S. T., Minster, R. L., Kamboh, M. I., Hamilton, R. L., & Wecht, C. H. (2005). Chronic traumatic encephalopathy in a National Football League player. *Neurosurgery, 57*(1), 128–134. https://doi.org/10.1227/01.neu.0000163407.92769.ed
180. Wolfson, D. I., Kuhn, A. W., Kerr, Z. Y., Brett, B. L., Yengo-Kahn, A. M., Solomon, G. S., & Zuckerman, S. L. (2020). Chronic traumatic encephalopathy research viewed in the public domain: what makes headlines?. *Brain injury, 34*(4), 528-534. https://doi.org/10.1080/02699052.2020.1725843
181. Bieniek, K. F., Cairns, N. J., Crary, J. F., Dickson, D. W., Folkerth, R. D., Keene, C. D., Litvan, I., Perl, D. P., Stein, T. D., Vonsattel, J., Stewart, W., Dams-O'Connor, K., Gordon, W. A., Tripodis, Y., Alvarez, V. E., Mez, J., Alosco, M. L., McKee, A. C., Babcock, D., . . . Koroshetz, W. (2021). The second NINDS/NIBIB consensus meeting to define neuropathological criteria for the diagnosis of chronic traumatic encephalopathy. *Journal of Neuropathology & Experimental Neurology, 80*(3), 210-219. https://doi.org/10.1093/jnen/nlab001
182. Katz, D. I., Bernick, C., Dodick, D. W., Mez, J., Mariani, M. L., Adler, C. H., Alosco, M. L., Balcer, L. J., Banks, S. J., Barr, W. B., Brody, D. L., Cantu, R. C., Dams-O'Connor, K., Geda, Y. E., Jordan, B. D., McAllister, T. W., Peskind, E. R., Petersen, R. C., Wethe, J. V., . . . Stern,

R. A. (2021). National Institute of Neurological Disorders and Stroke consensus diagnostic criteria for traumatic encephalopathy syndrome. *Neurology, 96*(18), 848-863. https://doi.org/10.1212/WNL.0000000000011850
183. Iverson, G. L., & Gardner, A. J. (2021). Symptoms of traumatic encephalopathy syndrome are common in the US general population. *Brain Communications, 3*(1). https://doi.org/10.1093/braincomms/fcab001
184. Sweden's Communes & Regions (2022). Regionernas planering och genomförande avseende vaccinering mot covid-19, delrapport 12. Retrieved 10 March 2025 from https://skr.se/download/18.3bf105b617db3dab4fe4cebe/1640161306777/Regionernas-planering-och-genomforande%20avseende-vaccinering-mot-covid-19_delrapport-12.pdf
185. Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*, *16*(9), 606-613.
186. Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of internal medicine*, *166*(10), 1092-1097.
187. Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The Patient Health Questionnaire-2: validity of a two-item depression screener. *Medical care*, *41*(11), 1284-1292.
188. Kroenke, K., Spitzer, R. L., Williams, J. B., Monahan, P. O., & Löwe, B. (2007). Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Annals of internal medicine*, *146*(5), 317-325. https://doi.org/10.7326/0003-4819-146-5-200703060-00004
189. EliteProspects (2025). SHL 2022-2023. Retrieved 10 March 2025 from https://www.eliteprospects.com/league/shl/2022-2023
190. HockeyArena.se (2024). SHL Löner 2024-2025 – Se vem som tjänar mest. Retrieved 10 March 2025 from https://www.hockeyarena.se/shl/loner/
191. EliteProspects (2025). HockeyAllsvenskan 2022-2023. Retrieved 10 March 2025 from https://www.eliteprospects.com/league/hockeyallsvenskan/2022-2023
192. Wörner, T., Kauppinen, S., & Eek, F. (2024). Same game, different worlds? General conditions, perceived stress, and associations between stress and past season injuries in elite female and male ice hockey players. *BMC Sports Science, Medicine and Rehabilitation*, *16*(1), 69.
193. EliteProspects (2025). SDHL 2023-2024. Retrieved 10 March 2025 from https://www.eliteprospects.com/league/sdhl-w/2023-2024
194. Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). *The alcohol use disorders identification test* (pp. 1-37). Geneva: World Health Organization.
195. Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., & Pallesen, S. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study. *Psychology of addictive behaviors*, *30*(2), 252. https://doi.org/10.1037/adb0000160
196. Gothenburg Institute for Stress Medicine. https://stressmedicin.com.
197. Ferris, J. A., & Wynne, H. J. (2001). *The Canadian problem gambling index* (pp. 1-59). Ottawa, ON: Canadian Centre on substance abuse.
198. Åkesdotter, C., Kenttä, G., Eloranta, S., Håkansson, A., & Franck, J. (2022). Prevalence and comorbidity of psychiatric disorders among treatment-seeking elite athletes and high-performance coaches. *BMJ Open Sport & Exercise Medicine*, *8*(1), e001264. https://doi.org/10.1136/bmjsem-2021-001264
199. Braun, V., & Clarke, V. (2022). Conceptual and design thinking for thematic analysis. *Qualitative psychology*, *9*(1), 3-26. https://doi.org/10.1037/qup0000196
200. Håkansson, A., Moesch, K., & Kenttä, G. (2022). COVID-19-related impact on mental health and career uncertainty in student-athletes—Data from a cohort of 7,025 athletes in an elite sport

high school system in Sweden. *Frontiers in Sports and Active Living*, *4*, 943402. https://doi.org/10.3389/fspor.2022.943402
201. Hallgren, M., Vancampfort, D., Nguyen, T. T. D., Ekblom-Bak, E., Wallin, P., Andersson, G., & Lundin, A. (2021). Physical activity, sedentary behavior, and cardiorespiratory fitness in hazardous and non-hazardous alcohol consumers. *American Journal of Health Promotion*, *35*(5), 669-678. https://doi.org/10.1177/0890117120985830
202. Henzel, V., & Håkansson, A. (2021). Hooked on virtual social life. Problematic social media use and associations with mental distress and addictive disorders. *PloS one*, *16*(4), e0248406. https://doi.org/10.1371/journal.pone.0248406
203. Zarate, D., Hobson, B. A., March, E., Griffiths, M. D., & Stavropoulos, V. (2023). Psychometric properties of the Bergen Social Media Addiction Scale: An analysis using item response theory. *Addictive Behaviors Reports*, *17*, 100473. https://doi.org/10.1016/j.abrep.2022.100473
204. Persson, R., Österberg, K., Viborg, N., Jönsson, P., & Tenenbaum, A. (2016). The Lund University Checklist for Incipient Exhaustion–a cross–sectional comparison of a new instrument with similar contemporary tools. *BMC public health*, *16*, 1-12. https://doi.org/10.1186/s12889-016-3001-5
205. Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer publishing company.
206. Kontro, T. K., Tolvanen, A., Sarna, S., Kaprio, J., & Kujala, U. M. (2021). Physical activity, use of alcohol and smoking in middle-aged and aging men. A longitudinal study among Finnish male former athletes and controls. *European Journal of Sport Science*, *21*(3), 460-469. https://doi.org/10.1080/17461391.2020.1761889
207. Kontro, T. K., Sarna, S., Kaprio, J., & Kujala, U. M. (2018). Mortality and health-related habits in 900 Finnish former elite athletes and their brothers. *British journal of sports medicine*, *52*(2), 89-95. https://doi.org/10.1136/bjsports-2017-098206

Printed by Media-Tryck, Lund 2025 NORDIC SWAN ECOLABEL 3041 0903

FACULTY OF MEDICINE

Department of Psychiatry
Clinical Sciences Lund

Lund University, Faculty of Medicine
Doctoral Dissertation Series 2025:58
ISBN 978-91-8021-711-8
ISSN 1652-8220