







# Mental health problems in elite sport: the difference in the distribution of mental distress and mental disorders among a sample of Norwegian elite athletes

Tom Henning Oevreboe <sup>1</sup>, Andreas Ivarsson <sup>2,3</sup>, Jorunn Sundgot-Borgen <sup>4</sup>, Ann Kristin Skrando Knudsen <sup>5</sup>, Anne Reneflot <sup>6</sup>, Anne Marte Pensgaard <sup>1</sup>

**To cite:** Oevreboe TH, Ivarsson A, Sundgot-Borgen J, *et al*. Mental health problems in elite sport: the difference in the distribution of mental distress and mental disorders among a sample of Norwegian elite athletes. *BMJ Open Sport & Exercise Medicine* 2023;**9**:e001538. doi:10.1136/bmjsem-2023-001538

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjsem-2023-001538>).

Accepted 20 June 2023



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

**Correspondence to**  
Tom Henning Oevreboe;  
tomho@nih.no

## ABSTRACT

**Objectives** To, based on diagnostic interviews, investigate the distribution of mental disorders among a sample of Norwegian elite athletes with ‘at-risk scores’ on a self-report questionnaire measuring symptoms of mental health problems. Then, to investigate the relationship between ‘at-risk scores’ and diagnosed mental disorders.

**Methods** A two-phase, cross-sectional design was used. In phase 1, 378 elite athletes completed a questionnaire, including validated self-report psychiatric instruments assessing symptoms of mental disorders. In phase 2, we assessed the 30-day presence of the same disorders through diagnostic interviews with the athletes with ‘at-risk scores’ using the fifth version of the Composite International Diagnostic Interview.

**Results** Two hundred and eighty athletes (74.1%) had an ‘at-risk score,’ and 106 of these athletes (37.9%) completed diagnostic interviews. Forty-seven athletes (44.3%) were diagnosed with a mental disorder. Sleep problems (24.5%) and obsessive-compulsive disorder (OCD) and OCD-related disorders (18.9%), mainly represented by body dysmorphic disorder (BDD), were most common. Anxiety disorders (6.6%), eating disorders (5.7%) and alcohol use disorder ( $\leq 4.7\%$ ) were less frequent. Affective disorders, gambling and drug use disorder were not present. Results from self-report questionnaires did not, in most cases, adequately mirror the number of mental disorders identified using diagnostic interviews.

**Conclusions** Using self-report questionnaires to map mental distress among elite athletes can be beneficial. If the aim, however, is to investigate mental disorders, one should move beyond self-report questionnaires and use diagnostic interviews and diagnostic instruments. In our study, sleep problems and BDD were the most prevalent. Longitudinal studies are needed to investigate these findings further.

## INTRODUCTION

In their consensus statement from 2019, the International Olympic Committee (IOC) underlines that research focusing

on mental health problems in elite sport should clarify whether mental health symptoms or mental disorders are measured.<sup>1</sup> Researchers support this perspective and claim that there is a need for studies that distinguish symptoms from disorders.<sup>2-3</sup> Admittedly, symptoms of mental health problems themselves, often referred to as mental distress,<sup>4</sup> can be challenging for an elite athlete.<sup>1</sup> Mental disorders are, however, defined as illnesses in a medical sense and, according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), ‘... characterised by clinically significant disturbance in an individual’s cognition, emotion regulation, or behaviour that reflects a dysfunction in the psychological, biological or development processes underlying mental functioning’, and are more often ‘... associated with significant distress or disability in social, occupational or other important activities’.<sup>5</sup> Hence, it is likely that a mental disorder will more negatively influence an elite athlete’s general functioning and performance compared with symptoms of mental health problems and experienced mental distress of a shorter duration. Still, by solely using self-report questionnaires, most research has focused on symptoms rather than diagnosed mental disorders.<sup>1 2 6-9</sup> Some of this research shows that symptoms of mental health problems are common among elite athletes,<sup>1</sup> that elite athletes have substantial symptom loads within a range of mental health issues<sup>1 10</sup> and that the prevalence of mental health problems is comparable to the general population.<sup>11</sup>

Although self-report questionnaires may be sensitive tools to measure mental distress and symptoms of mental disorders, they often

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

- ⇒ Research has shown that elite athletes report symptoms of mental health problems to the same degree as the general population within a range of mental health issues.
- ⇒ Most of the research has used self-report questionnaires, and it is difficult to know if the results from self-report questionnaires correctly mirror the distribution of mental disorders.
- ⇒ It is strongly advised to conduct diagnostic interviews to identify whether a mental disorder is present.
- ⇒ Previous research may not give a valid picture of mental disorders among elite athletes.

**WHAT THIS STUDY ADDS**

- ⇒ This study clarifies and underlines the difference between mental distress (symptoms of mental health problems) and mental disorder.
- ⇒ Mental disorders are substantially less frequent than mental distress—in our study, less than half of the ‘at-risk’ athletes were identified with a mental disorder that satisfied diagnostic criteria.
- ⇒ Sleep problems and body dysmorphic disorder were the most prevalent mental disorders among the elite athletes in this study.
- ⇒ More common mental disorders among the general population, that is, affective disorders, anxiety disorders and alcohol use disorder, seemed less prevalent in our sample when assessing 30 days or point prevalence.

**HOW MIGHT THIS STUDY AFFECT RESEARCH, PRACTICE AND POLICY**

- ⇒ Using self-report questionnaires and screening instruments in research and clinical settings can be advantageous if the aim is to map mental distress and symptoms of mental disorders.
- ⇒ If the objective is to address mental disorders, it is necessary to conduct diagnostic interviews.
- ⇒ Ideally, one should choose a two-phase design if the aim is to compare mental distress and mental disorders.
- ⇒ If results from self-report questionnaires indicate mental health problems, one should follow-up with diagnostic interviews, for example, to ensure relevant preventive work and appropriate treatment.

have a limited reference period, usually 1 week or 2 weeks.<sup>12</sup> Some of the symptoms measured could hence be normal states within elite sport fluctuating over time because elite athletes experience ups and downs and different emotions.<sup>3 6</sup> Furthermore, even if self-report questionnaires can be relevant to detect possible short-time fluctuations in mental health, they rarely assess functional impairment.<sup>13</sup> Thus, relying exclusively on results from self-report questionnaires could overestimate the prevalence of mental health problems in elite sport.<sup>3 13–15</sup> On the other hand, diagnostic interviews and diagnostic instruments also focus on functional impairment, disability and duration of symptoms, making it possible to conclude whether a mental disorder is present or not.<sup>13 16</sup>

Few studies have, to the best of our knowledge, compared results from self-report questionnaires with results from diagnostic interviews when researching mental health problems among elite athletes. Consequently, little is known about whether results from

self-report questionnaires reflect the actual prevalence of mental disorders in this group.

**Purpose of this study**

The purposes of the study are to (1) based on diagnostic interviews, investigate the distribution of mental disorders among a sample of Norwegian elite athletes with ‘at-risk scores’ on self-report questionnaires measuring symptoms of different mental health problems and (2) investigate the relationship between ‘at-risk scores’ and mental disorders identified through diagnostic interviews.

**METHODS****Design**

This study was a two-phase study. In phase 1, we distributed an online self-report questionnaire covering symptoms of different mental disorders to elite athletes in Norway (table 1).<sup>17</sup>

In phase 2, we conducted diagnostic interviews with participants with an ‘at-risk score’ on one or more of the included mental disorders in the self-report questionnaire. Data from the online questionnaire was collected between June 2020 and September 2020.<sup>17</sup> The diagnostic interviews were conducted between June 2020 and November 2020. We assessed a range of mental disorders in the diagnostic interview (table 2).

We co-operated with the Norwegian Olympic Training Centre (Olympiatoppen), the Norwegian Athlete Association (NISO) and the Norwegian Athlete Committee (NAC) to recruit athletes for participation. We consulted NAC in developing the survey.

**Population**

We invited all athletes above 18 years registered at Olympiatoppen (sample 1: N=358) and all athletes above 18 years with membership in NISO (sample 2: N=932) to participate in this two-phase study. Athletes who were members of NISO but also registered at Olympiatoppen were selected for sample 1. The athletes in sample 1 compete at the highest (or high) international level, receive a stipend from Olympiatoppen and are classified as Tier 4 or 5.<sup>18</sup> The athletes in sample 2 mainly compete at a high or the highest national level and are usually classified as Tier 3.<sup>18</sup>

Because we wanted to follow-up a selected group of athletes in phase 2 of the study, participation was not anonymous. Participants were informed about the possibility of receiving psychiatric treatment from a clinical psychologist or a psychiatrist if needed. All participants provided written informed consent.

**Sample and assessment procedure**

Participants in phase 1 of the study (n=378) were coded as ‘not at-risk’ (0) or ‘at-risk’<sup>1</sup> regarding symptoms of mental disorders and risk consumption for alcohol and drug abuse based on recommended cut-off scores for each of the instruments (table 1). Two hundred and

**Table 1** The psychiatric assessment instruments included in the self-report questionnaire used in phase 1, including reference period and ‘at-risk score’ used to select participants for diagnostic interviews

Instrument	Abbreviation	Domain	Reference period	Clinical cut-off score/at-risk score
Hopkins Symptoms Check List—10-item version	HSCL-10	Symptoms of depression and anxiety disorders	Last 7 days	≥1.85 (average score)
Bergen Insomnia Scale	BIS	Symptoms of problems related to sleep (insomnia)	Last month (days per week)	≥3 on one of the items 1–4 and ≥3 on one of the items 5–6
The Eating Disorder Examination—Questionnaire Short	EDE-QS	Symptoms of eating disorders	Last week	≥15 (total score)
Canadian Problem Gambling Index	CPGI	Symptoms of gambling disorder	Last 12 months	≥3 (total score) 3–7=moderate risk-gambler 8–27=problem gambler
The Alcohol Use Disorders Identification Test—Consumption	AUDIT-C	Identifies hazardous drinkers or active alcohol use disorders (including alcohol abuse or dependence)	<ul style="list-style-type: none"> <li>▶ Present usage? Yes/No</li> <li>▶ How often (weekly/monthly)?</li> <li>▶ How much?</li> </ul>	Male: ≥4 (total score) 4–7=increased risk 8–12=high risk Female: ≥3 (total score) 3–7=increased risk 8–12=high risk
Drug Use Disorders Identification Test	DUDIT	Symptoms of substance abuse, harmful use and drug dependence	<ul style="list-style-type: none"> <li>▶ Present usage? Y/N</li> <li>▶ How often (weekly/monthly)?</li> <li>▶ How much?</li> </ul>	Male: ≥6 (total score) Female: ≥2 (total score)

The instruments were selected after consulting experts in Norway at the following institutions: Norwegian Institute of Public Health, National Competence Center for Sleep Disorders, Regional Center for Eating Disorders (RASP), Department of Psychosocial Science of University of Bergen, Norwegian Centre for Addiction Research and Norwegian National Advisory Unit on Concurrent Substance Abuse and Mental Health Disorders. Four aspects were given priority when selecting the instrument. (1) Is the instrument validated for the Norwegian population? (2) Is the instrument used in research on the general population in Norway? (3) Do the different experts recommend the instrument? (4) Is the number of items acceptable? For more information about the instruments, see online supplemental appendix 1.

eighty athletes (74.1%) had an ‘at-risk score’ on one or more of the included disorders. Forty six of these athletes only consented to participate in phase 1 of the study, leaving the number of possible participants in phase 2 to

234. These participants were approached once by email and asked if they were willing to participate in the diagnostic research interview. One hundred and ten athletes (47.0%) agreed to participate, and 106 (45.3%) interviews were valid (figure 1).

**Table 2** Categories of mental disorders assessed in phase 2 of the study

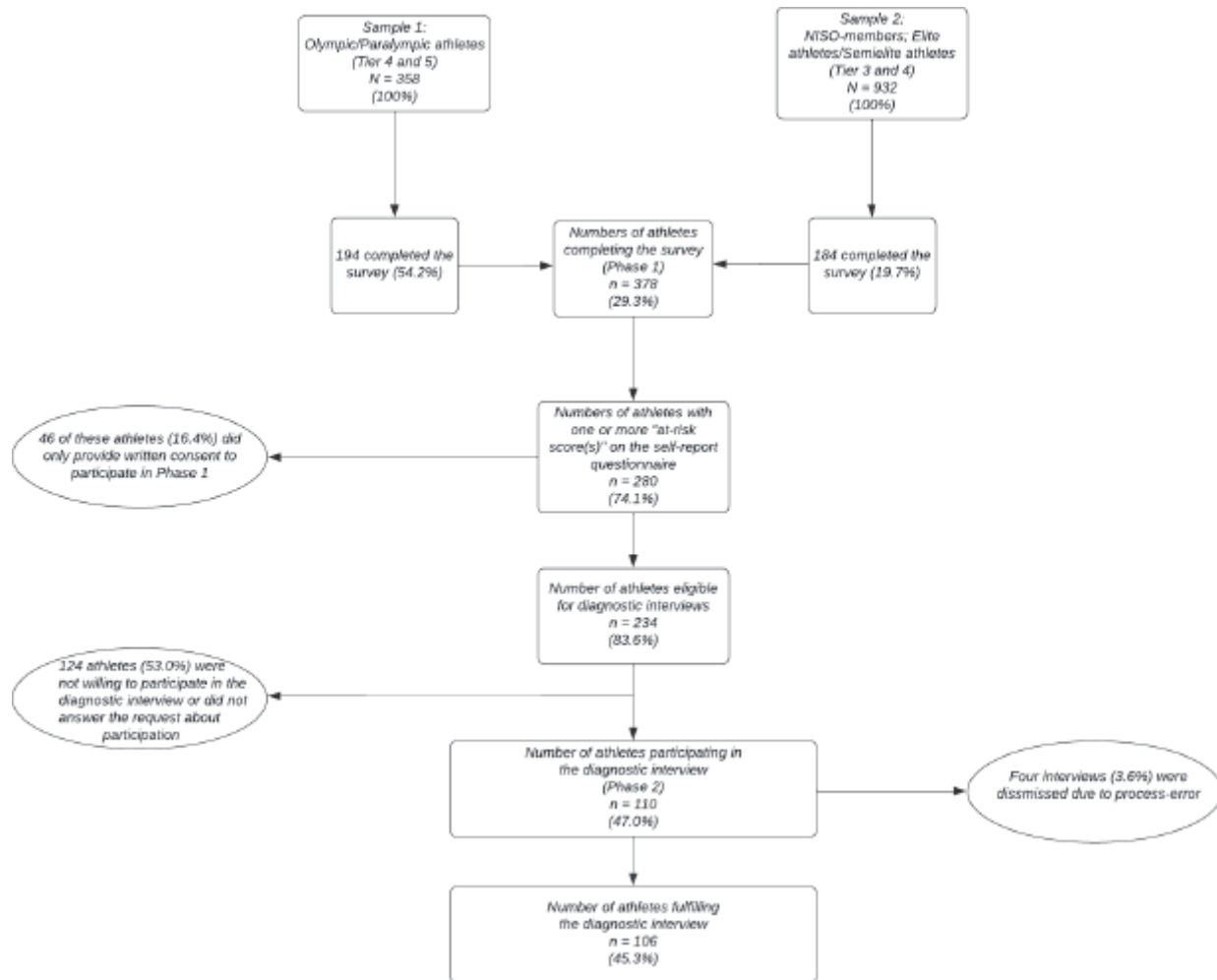
Disorder	Types (subcategories)
Affective disorders	Depressive episode, depressive disorder, hypomanic episode, manic episode, subthreshold bipolar disorder, bipolar I disorder, bipolar II disorder
Anxiety disorders	Generalised anxiety disorder, panic attack, panic disorder, specific phobia, social anxiety disorder, agoraphobia
OCD and OCD-related disorders	OCD, BDD, hoarding, excoriation disorder, trichotillomania
Sleep problems	No subcategories diagnosed
Eating disorder	Anorexia nervosa, AN-R, bulimia nervosa, AN-BP, binge eating disorder, other specified feeding and eating disorder, pica, rumination disorder, avoidant/restrictive food intake disorder, unspecified feeding or eating disorder
Gambling disorder	No subcategories diagnosed
Alcohol use disorder	No subcategories diagnosed
Drug use disorder	No subcategories diagnosed
AN-BP, anorexia nervosa binge/purge subtype; AN-R, anorexia nervosa restrictive subtype; BDD, body dysmorphic disorder; OCD, obsessive-compulsive disorder.	

### Methods of diagnosing mental disorders

To decide whether an athlete met the diagnostic criteria for a mental disorder, we used relevant parts of the Norwegian-translated fifth version of the Composite International Diagnostic Interview (CIDI 5.0) developed by the WHO.<sup>19</sup> CIDI is a comprehensive, structured diagnostic interview used to assess mental disorders according to the definition and criteria of ICD-10 and DSM-5.<sup>12 20</sup> It is developed to be used as a research interview by trained laypeople.<sup>19 21</sup> The diagnoses are identified later using diagnostic algorithms, aiming to reduce the subjective element in the interview.

Five experienced clinical psychologists and one experienced sport psychologist with clinical training conducted the diagnostic interviews, in which CIDI was used as the only instrument. All interviewers completed a 1-day training course in conducting the interview, arranged by the Norwegian Institute of Public Health.

Since CIDI does not include any questions about eating disorders or problems related to gambling, we selected the Eating Disorder Assessment for DSM-5 (EDA-5) and the Norwegian versions of NORC DSM Screen for Gambling Problems (NODS) as a supplement for ‘at-risk’ athletes within these domains.<sup>22–24</sup> Both instruments are relevant



**Figure 1** Flowchart of participants who fulfilled the diagnostic interview. Of the 378 athletes participating in phase 1 of the study, 280 athletes (74.1%) had one or more ‘at-risk score(s)’ on the self-report questionnaire. Of these 280 athletes, 234 were eligible participants in phase 2 of the study. 110 athletes (47.0%) agreed to participate in the diagnostic interview in phase 2, and 106 interviews were completed (45.3%).

for diagnostic purposes and can be used in research.<sup>22–25</sup> When we included EDA-5 or NODS, an experienced clinical psychologist conducted the diagnostic interview.

Before the diagnostic interview started, we asked the athletes to rate any perceived changes in their mental health since the online survey. We also registered the number of days between the athlete answering the self-report questionnaire and participating in the diagnostic interview.

### Statistical analysis

Data were analysed using descriptive statistics to describe the participants and the prevalence of mental disorders. A mental disorder diagnosis was identified based on diagnostic algorithms from the World Mental Health Survey (30 days prevalence). Point prevalence was selected for the disorders not included in CIDI (ie, eating disorders and gambling disorder). To investigate potential statistical differences in prevalence between males and females, we calculated a 95% CI for the difference score. If the 95% CI did not include 0, it was considered a

significant gender difference (ie,  $p < 0.05$ ). To investigate the relationship between ‘at-risk scores’ and diagnosed mental disorders, we calculated the positive predictive value (PPV) of the different psychiatric instruments.

Due to recommendations from the Norwegian Data Protection Authority (Datatilsynet) about confidentiality when collecting sensitive data, we only reported the exact number of participants with a disorder if six or more were diagnosed.<sup>26</sup> If five or fewer were diagnosed, the results were reported as ‘ $\leq 5$ ’.

## RESULTS

### Participants

One hundred and six elite athletes completed the diagnostic interview (table 3), of which all had an ‘at-risk score’ on one or more of the screened disorders (online supplemental appendix 2). There were no statistically significant differences in any of the selected demographic variables between participants and non-participants in the diagnostic interview. Participants in the diagnostic

**Table 3** Overview of group affiliation, performance level and relevant demographic variables

Group affiliation	n	%
Olympic and Paralympic athletes (Sample 1)	57	53.8
NISO-athletes (Sample 2)	49	46.2
Performance level		
Highest international level; World Cup, World and European Championship, Olympics, Paralympics (Tier 4/5)	62	58.5
High international level; but not World Cup, World- and European Championships, Olympics, Paralympics (Tier 4)	13	12.3
Highest national level (Tier 3)	21	19.8
High national level (Tier 3)	10	9.4
Relevant demographic variables		
Female athletes	54	50.9
Male athletes	52	49.1
Mean age: 26.95 (SD=5.566, Range 19–51)	–	–
Average weekly practice: 16.43 hours (SD=4.292, Range 8–28)	–	–
Number of different sports included in the study	24	–
Individual sport, summer (no. of athletes)	26	24.5
Team sport, summer (no. of athletes)	47	44.3
Individual sport, winter (no. of athletes)	21	19.8
Team sport, winter (no. of athletes)	12	11.3
Full-time athletes	49	46.2
Part-time athletes (combine their sport with studies and/or work)	57	53.8
Medals from European Championship, World Championship, Olympics, or Paralympics	44	41.5
Able-bodied athletes	100	94.3
Paralympic athletes	6	5.7

interview, however, had a statistically significant higher 'at risk score' on Hopkins Symptoms Check List—10-item version (HSCL-10) and Eating Disorder Examination—Questionnaire Short (EDE-QS) than non-participants.

The diagnostic interviews were conducted face to face (n=26/24.5%), by phone (n=41/38.7%) or by video (n=39/36.8%). On average, an interview lasted for 61.4 min (SD=17.8 min, range=90 min (30–120 min)). The average number of days between phase 1 and phase 2 of the study was 54 (SD=30.8 days, mode=36 days, range=126 days (7–133 days)). Most athletes self-reported no or minor changes in their mental health between these two phases (n=91/85.8%).

### Distribution of mental disorders

Forty seven of the 106 athletes (44.3%) participating in the diagnostic interview met the diagnostic criteria for a mental disorder. Sleep problems were most common, followed by obsessive-compulsive disorder (OCD) and OCD-related disorders, anxiety disorders and eating disorders. Alcohol use disorder was the least common disorder among the identified disorders. No athletes were diagnosed with affective, gambling or drug use disorders (table 4).

Significantly more female than male athletes had an eating disorder. No other significant gender differences were found (table 4). Thirty-six athletes (76.6%) were diagnosed with one mental disorder, and 11 (23.4%) had 2 or 3 mental disorders.

### The relationship between 'at-risk scores' and mental disorders

Considerably fewer athletes were diagnosed with a mental disorder compared with the number of 'at-risk scores'. The PPVs of most of the psychiatric instruments included in the self-report questionnaire were less than 50%, indicating that many of the athletes with symptoms of mental disorder did not have a diagnosed disorder (table 5). A few athletes got diagnosed with a mental disorder even without an 'at-risk score' on the specific disorder.

### DISCUSSION

This study is, to the best of our knowledge, one of the first comprehensive studies focusing on mental disorders among elite-class and world-class athletes where a two-phase design is used. A two-phase design is sometimes referred to as the gold standard in assessing prevalence rates.<sup>27</sup>

Only 44.3% of the athletes who conducted diagnostic interviews were diagnosed with a mental disorder, where sleep problems and OCD and OCD-related disorders, mainly BDD, were most frequent. Hence, our data imply that relying solely on self-report questionnaires could overestimate mental health problems within elite sport. Other studies, inside and outside the elite sport population, reveal the same pattern, that is, 'at-risk scores' on self-report questionnaires do not necessarily imply a mental disorder.<sup>28 29</sup>

### Research issues and clinical implications

When researching mental health in elite sport, an essential question is what underlying theoretical perspectives one adopts.<sup>3</sup> If the aim is to research mental health problems, it is vital to determine if the focus is on mental distress, mental disorders or both. For instance, it could be beneficial to use self-report questionnaires when mapping symptoms of mental disorders and mental distress,<sup>30</sup> for example, to reveal different 'at-risk' disorders and prevent the development of mental disorders. Self-report questionnaires also enable a large amount of data collection, it is possible to generalise the findings from them if the sample is representative and they are



**Table 4** Distribution of mental disorders among the 106 athletes completing the diagnostic interview, with gender differences (30 days prevalence for affective disorders, anxiety disorders, OCD and OCD-related disorders, sleep problems, alcohol use disorder and drug use disorder. Point prevalence for eating disorders and gambling disorder)

Mental disorder	n total	% total	n male	% male	n female	% female	Δ95% CI
Affective disorders (incl. depressive episode, depressive disorder, hypomanic episode, manic episode, subthreshold bipolar disorder, bipolar I disorder, bipolar II disorder)	0	0	0	0	0	0	n/a
<b>Anxiety disorders</b> (incl. <b>generalised anxiety disorder (n=≤5)*</b> , <b>panic attack (n=≤5)*</b> , <b>panic disorder (n=≤5)*</b> , <b>specific phobia (n=≤5)*</b> , social anxiety disorder, agoraphobia)	7	6.6	≤5	≤9.6	≤5	≤9.3	[-0.1496, 0.0396]
<b>OCD and OCD-related disorders</b> (incl. <b>OCD (n= ≤5)*</b> , <b>BDD (n=15)*</b> , <b>hoarding (n=≤5)*</b> , <b>excoriation disorder (n=≤5)*</b> , <b>trichotillomania (n=≤5)*</b> )	20	18.9	8	15.4	12	22.2	[-0.2170, 0.0810]
<b>Sleep problems</b> (do not measure specific diagnosis)	26	24.5	12	23.1	14	25.9	[-0.1918, 0.1358]
<b>Eating disorders</b> (incl. anorexia nervosa, AN-R; anorexia nervosa restrictive subtype, AN-BP; anorexia nervosa binge-purge subtype. <b>bulimia nervosa (n=≤5)*</b> , <b>binge eating disorder (n=≤5)*</b> , other specified feeding and eating disorder, pica, rumination disorder, avoidant/restrictive food intake disorder, <b>unspecified feeding or eating disorder (n=≤5)*</b> )	6	5.7	0	0	6	11.1	[-0.1990, -0.0230]
Gambling disorder (no subcategories)	0	0	0	0	0	0	n/a
<b>Alcohol use disorder</b> (no subcategories)	≤5	≤4.7	≤5	≤9.6	0	0	[-0.0135, 0.0895]
Drug use disorder (no subcategories)	0	0	0	0	0	0	n/a
Number of athletes with one or more diagnosed disorder(s)	47	44.3	20	38.5	27	50.0	[-0.3042, 0.0742]
Number of athletes with no diagnosed disorder(s)	59	55.7	32	61.5	27	50.0	[-0.0742, 0.3042]

\***Bold**=the mental disorders diagnosed within the different categories and the number of athletes diagnosed with each type of disorder within the category.  
AN-BP, anorexia nervosa binge/purge subtype; AN-R, anorexia nervosa restrictive subtype; BDD, body dysmorphic disorder; OCD, obsessive-compulsive disorder.

cost effective.<sup>30</sup> One should, however, carefully consider the appropriate questionnaire when using self-report questionnaires. Some seem to overestimate mental health problems more than others (eg, AUDIT-C). This could significantly exceed the true prevalence,<sup>13</sup> which could be a methodological challenge. Even if one should expect certain false positives, it can blur the distinctions between low and high prevalence groups.<sup>13</sup> When studying mental disorders within a relatively low prevalence group, one should be aware that it is challenging to find self-report questionnaires with sufficient PPV, even if both the sensitivity and specificity scores are high.<sup>31</sup> Some self-report questionnaires could also be too general and do not necessarily capture specific diagnoses within the targeting domain. For instance, in our sample, we had participants without an 'at-risk score' on HSCL-10 who still was diagnosed with an anxiety disorder (n=2) and an OCD and OCD-related disorder (n=9). Hence, one

should consider the specific mental disorder one wants to target and the accuracy of the questionnaire when selecting the instruments.<sup>13 32 33</sup> Still, to get an overview of the most common mental disorders within elite sport, one should also implement diagnostic interviews and diagnostic instruments in research<sup>13</sup> even if diagnostic interviews are more expensive, time consuming and resource demanding.<sup>34</sup>

The present study shows that sleep problems are common among elite athletes diagnosed with mental disorders. This result aligns with other studies.<sup>35 36</sup> It has been stated that sleep problems could negatively influence elite athletes' preparation, performance and recovery.<sup>36 37</sup> In addition, poor sleep could increase the risk of injury.<sup>38</sup> Furthermore, sleep disturbances and sleep disorders could also be prodromal symptoms of depression and a significant risk factor for subsequent depression.<sup>39</sup> Hence, teaching elite athletes about

**Table 5** The relationship between 'at-risk scores' obtained from the self-report questionnaire and mental disorders obtained from the diagnostic interviews, expressed in PPV

Measure	'At-risk score'	'At risk score' and relevant diagnosed disorder	PPV	Total diagnosed disorders
HSCL-10: total	36 (34.0%)	16 (15.1%)	44.4%	27 (25.5%)
HSCL-10: affective disorders	36 (34.0%)	0 (0.0%)	0.0%	0 (0.0%)
HSCL-10: anxiety disorders	36 (34.0%)	5 (4.7%)	13.9%	7 (6.6%)
HSCL-10: OCD and OCD-related disorders	36 (34.0%)	11 (10.4%)	30.6%	20 (18.9%)
BIS	65 (61.3%)	23 (21.7%)	35.4%	26 (24.5%)
EDE-QS	9 (8.5%)	6 (5.7%)	66.7%	6 (5.7%)
CPGI	8 (7.5%)	0 (0.0%)	0.0%	0 (0.0%)
AUDIT-C	82 (77.4%)	≤5 (≤4.7%)	≤6.1%	≤5 (≤4.7%)
DUDIT	≤5 (≤4.7)	0 (0.0%)	0.0%	0 (0.0%)

AUDIT-C, Alcohol Use Disorders Identification Test – Consumption; BIS, Bergen Insomnia Scale; CPGI, Canadian Problem Gambling Index; DUDIT, Drug Use Disorders Identification Test; EDE-QS, Eating Disorder Examination - Questionnaire Short; HSCL-10, Hopkins Symptoms Check List - 10-item version; OCD, obsessive-compulsive disorder; PPV, positive predictive value.

effective sleep hygiene, optimising sleep and offering evidence-based treatments for those with a sleep disorder is essential.

Another interesting result is that 15 of the 20 athletes diagnosed with OCD and OCD-related disorders were diagnosed with BDD. Research shows that BDD is often an underdiagnosed condition in the general population.<sup>40</sup> This could also be true within the elite sport population. To address this issue, BDD should be a topic in a clinical setting with elite athletes.<sup>41</sup> In addition, both researchers and clinicians should be aware that symptoms of BDD, like body image disturbance, could influence the development and maintenance of relative energy deficiency in sport and eating disorders.<sup>42–44</sup> The research is sparse. Hence, the possible associations should be investigated further, including whether CIDI sufficiently separates typical athletic concerns about weight, shape and body composition from BDD.

It is worth noticing that no athletes were diagnosed with an affective disorder (eg, depression) in this study. It could be that athletes suffering from depression, or other severe affective disorders, are more reluctant to participate. For instance, research has shown that those struggling with more severe mental health problems could be less likely to participate in studies like this.<sup>45</sup> It could also be that elite athletes do not acknowledge or recognise depressive symptoms.<sup>1</sup> Research has shown, however, that less than 30% of patients with a positive screen for depression are actually diagnosed with depression.<sup>13</sup> More longitudinal research is needed to see if athletes' mental health fluctuates during a competitive season depending on both sport-specific and more general factors negatively influencing their lives.

Our results show that 23.4% were diagnosed with more than one disorder. Even if comorbidity seems less common in the elite sport population than in the general population, where it can range between 44% and 99%,<sup>46</sup> it is important to emphasise that comorbidity often will be

associated with more severe symptoms, reduced quality of life and function loss.<sup>47–49</sup>

We want to emphasise that those athletes who only show symptoms of mental distress also could experience challenges in their daily lives.<sup>1</sup> Still, it is essential to acknowledge that athletes with mental disorders are more likely to suffer and struggle in and outside the elite sport arena. Hence, we must be aware of the differences between mental distress and mental disorders when communicating about mental health problems with elite athletes. Finally, it is essential that treatment offered within elite sport could help athletes with different pathological issues.<sup>2</sup>

When conducting this kind of research on elite athletes, comparing the results with other groups (eg, the general population) can be helpful but challenging (eg, due to using different measures).<sup>1 7 14 27</sup> We encourage, however, comparative research to understand the similarities and differences between elite athletes and other societal groups.

### Limitations

The current study has some important limitations. Only 378 out of 1290 (29.3%) elite athletes participated in phase 1,<sup>17</sup> and we have limited information about the non-responders from this part of the study. Hence, one should be careful to generalise the results to the entire elite athlete population.

Although most of the athletes (85.8%) did not self-report any major changes in their mental health between the initial screening and the diagnostic interview, a shorter time frame between phase 1 and phase 2 would be more ideal.

Even if the psychiatric measures selected in this study were validated for the Norwegian population, they are not validated for the elite athlete population. As mentioned by several researchers, this could be a methodological challenge when gathering data from this

population.<sup>1 2 6 8</sup> Recently, the IOC's Sport Mental Health Assessment Tool was released.<sup>50</sup> This tool may be more suitable for research involving mental health problems and athletes once validated in Norwegian.

Finally, defining the threshold between clinical and subclinical conditions is sometimes tricky.<sup>8</sup> Ideally, a group of 'non-at-risk' athletes should have been invited to the diagnostic interview to examine false negatives in the self-report questionnaire even closer. This would also make it possible to calculate the sensitivity and specificity score of the instruments, as well as the negative predictive value.

## Conclusions

Despite the limitations of this study, it shows that elite athletes are experiencing various mental disorders. In our sample, sleep problems and BDD are the most common. However, more than half of the athletes who conducted diagnostic interviews were not diagnosed with a mental disorder, even with one or more 'at-risk scores'. Hence, it is essential to note that scores on self-report questionnaires more often identify positive cases compared with clinical interviews, which is often also the intention of these instruments. If the aim is to map mental distress and symptoms of mental disorders, using self-report questionnaires in research and clinical settings can be advantageous. Initial screening with self-report questionnaires could guide the following steps and demands significantly fewer resources than diagnostic interviews. However, when making conclusions about mental health problems and mental disorders in elite sport, one should be careful when interpreting results from studies based solely on self-report questionnaires. Consequently, one should move beyond self-report questionnaires and use diagnostic interviews and diagnostic instruments when examining mental disorders within elite sport.<sup>3 14</sup>

## Author affiliations

<sup>1</sup>Department of Sport and Social Sciences, Norwegian School of Sports Sciences, Oslo, Norway

<sup>2</sup>School of Health and Welfare, Halmstad University, Halmstad, Sweden

<sup>3</sup>Department of Sport Science and Physical Education, University of Agder, Kristiansand, Norway

<sup>4</sup>Department of Sports Medicine, Norwegian School of Sports Sciences, Oslo, Norway

<sup>5</sup>Department of Disease Burden, Norwegian Institute of Public Health, Oslo, Norway

<sup>6</sup>Department of Mental Health and Suicide, Norwegian Institute of Public Health, Oslo, Norway

**Twitter** Anne Marte Pensgaard @ampensgaard

**Acknowledgements** The authors would like to thank all the athletes participating in this study. We would also like to thank The Norwegian Athlete Committee, NISO, and Olympiatoppen for their positive attitude and help in planning and conducting this research. In addition, we would like to thank Olympiatoppen for their financial support. Finally, we would like to thank Janne Amundsen, Linda Fordal, Dag Soerum, and Anette Svendsen, who helped us conduct diagnostic interviews, Camilla Lindvall Dahlgren and Staale Pallesen, who helped us select the appropriate diagnostic instruments for diagnosing eating disorders and gambling disorder, respectively, and Luigi Maglanoc and Haneef Awan at the IT Department at the University of Oslo for helping us with the online data management.

**Contributors** AMP, AI and THO proposed the initial idea and conducted some analysis. The analysis of the Composite International Diagnostic Interview data,

which identified the diagnoses, was conducted by AR and AKSK. JS-B targeted the topic focusing on body dysmorphic disorder, relative energy deficiency in sport, and eating disorders. All authors critically revised the manuscript and approved the final version. AMP is the guarantor of the final version.

**Funding** A grant from Olympiatoppen supported this study.

**Competing interests** AMP and THO also have part-time positions at Olympiatoppen. No other competing interests were declared

**Patient and public involvement** Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants. The Regional Committee for Medical Research Ethics—South-East Norway (REC South-East, reg. no 28432) and the Norwegian Social Science Data Services approved this research project (reg. no.: 752353). Participants gave informed consent to participate in the study before taking part.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request. The data include highly profiled elite athletes and cannot be fully shared due to confidentiality and sensitivity.

**Supplemental material** This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iDs

Tom Henning Oevreboe <http://orcid.org/0000-0003-4965-1018>

Andreas Ivarsson <http://orcid.org/0000-0002-8987-5975>

Jorunn Sundgot-Borgen <http://orcid.org/0000-0002-5291-5486>

Ann Kristin Skrando Knudsen <http://orcid.org/0000-0002-1218-798X>

Anne Reneflot <http://orcid.org/0000-0003-0536-5271>

Anne Marte Pensgaard <http://orcid.org/0000-0003-4690-9888>

## REFERENCES

- Reardon CL, Hainline B, Aron CM, *et al*. Mental health in elite athletes: International Olympic committee consensus statement (2019). *Br J Sports Med* 2019;53:667–99.
- Currie A, Blauwet C, Bindra A, *et al*. Athlete mental health: future directions. *Br J Sports Med* 2021;55:1243–4.
- Lundqvist C, Andersson G. Let's talk about mental health and mental disorders in elite sports: a narrative review of theoretical perspectives. *Front Psychol* 2021;12:700829.
- Horwitz AV. Distinguishing distress from disorder as psychological outcomes of stressful social arrangements. *Health (London)* 2007;11:273–89.
- Stein DJ, Palk AC, Kendler KS. What is a mental disorder? An exemplar-focused approach. *Psychol Med* 2021;51:894–901.
- Henriksen K, Schinke R, Moesch K, *et al*. Consensus statement on improving the mental health of high performance athletes. *Int J Sport Exerc Psychol* 2020;18:553–60.
- Kuettel A, Larsen CH. Risk and protective factors for mental health in elite athletes: a scoping review. *Int Rev Sport Exerc Psychol* 2020;13:231–65.
- Moesch K, Kenttä G, Kleinert J, *et al*. FEPSAC position statement: mental health disorders in elite athletes and models of service provision. *Psychol Sport Exerc* 2018;38:61–71.
- Perry C, Champ FM, Macbeth J, *et al*. Mental health and elite female athletes: a scoping review. *Psychol Sport Exerc* 2021;56:101961.



- 10 Foskett RL, Longstaff F. The mental health of elite athletes in the United Kingdom. *J Sci Med Sport* 2018;21:765–70.
- 11 Goutteborge V, Jonkers R, Moen M, *et al*. The prevalence and risk indicators of symptoms of common mental disorders among current and former Dutch elite athletes. *J Sports Sci* 2017;35:2148–56.
- 12 Knudsen AKS, Stene-Larsen K, Gustavson K, *et al*. Prevalence of mental disorders, suicidal ideation and suicides in the general population before and during the COVID-19 pandemic in Norway: a population-based repeated cross-sectional analysis. *Lancet Reg Health Eur* 2021;4:100071.
- 13 Thombs BD, Kwakkenbos L, Levis AW, *et al*. Addressing overestimation of the prevalence of depression based on self-report screening questionnaires. *CMAJ* 2018;190:E44–9.
- 14 Gorczynski PF, Coyle M, Gibson K. Depressive symptoms in high-performance athletes and non-athletes: a comparative meta-analysis. *Br J Sports Med* 2017;51:1348–54.
- 15 Goutteborge V, Hopley P, Kerkhoffs G, *et al*. Symptoms of common mental disorders in professional Rugby: an international observational descriptive study. *Int J Sports Med* 2017;38:864–70.
- 16 Kessler RC, Abelson J, Demler O, *et al*. Clinical calibration of DSM-IV diagnoses in the World Mental Health (WMH) version of the World Health Organization (WHO) composite International diagnostic interview (WMH-CIDI). *Int J Methods Psychiatr Res* 2004;13:122–39.
- 17 Pensgaard AM, Oevreboe TH, Ivarsson A. Mental health among elite athletes in Norway during a selected period of the COVID-19 pandemic. *BMJ Open Sport Exerc Med* 2021;7:e001025.
- 18 McKay AKA, Stellingwerf T, Smith ES, *et al*. Defining training and performance caliber: a participant classification framework. *Int J Sports Physiol Perform* 2021;17:317–31.
- 19 World Health Organization. Catalogue of WHO psychiatric assessment instruments. In: *WHO, Division of Mental Health*. Organization WH, 1995.
- 20 Kessler RC, Abelson J, Demler O, *et al*. The World Mental Health (WMH) survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *Int J Methods Psychiatr Res* 2004;13:122–39.
- 21 World Health Organization. The world health organization world mental health composite international diagnostic interview (WHO WMH-CIDI). 2022. Available: <https://www.hcp.med.harvard.edu/wmhcid/>
- 22 Dahlgren CL, Walsh BT, Vrabel K, *et al*. Eating disorder diagnostics in the Digital era: validation of the Norwegian version of the eating disorder assessment for DSM-5 (EDA-5). *J Eat Disord* 2020;8:30.
- 23 Sysko R, Glasofer DR, Hildebrandt T, *et al*. The eating disorder assessment for DSM-5 (EDA-5): development and validation of a structured interview for feeding and eating disorders. *Int J Eat Disord* 2015;48:452–63.
- 24 Brazeau BW, Hodgins DC. Psychometric evaluation of the NORC diagnostic screen for gambling problems (nods) for the assessment of DSM-5 gambling disorder. *Addict Behav* 2022;130:107310.
- 25 GersteinDHJ, Larison C, Engelman L. *Gambling Impact and Behavior Study*. Chicago, USA: National Opinion Research Center at the University of Chicago, 1999.
- 26 A guide to the Anonymisation of personal data. Oslo Datatilsynet; 2015.
- 27 Dahlgren CL, Stedal K, Wisting L. A systematic review of eating disorder prevalence in the Nordic countries: 1994–2016. *Nordic Psychology* 2018;70:209–27.
- 28 Martinsen M, Sundgot-Borgen J. Higher prevalence of eating disorders among adolescent elite athletes than controls. *Med Sci Sports Exerc* 2013;45:1188–97.
- 29 Scott HR, Stevelink SAM, Gafoor R, *et al*. Prevalence of post-traumatic stress disorder and common mental disorders in health-care workers in England during the COVID-19 pandemic: a two-phase cross-sectional study. *Lancet Psychiatry* 2023;10:40–9.
- 30 Cautin RL, Lilienfeld SO. *The Encyclopedia of Clinical Psychology, 5 Volume Set*. John Wiley & Sons, 2015.
- 31 Zimmerman M. Positive predictive value: a clinician's guide to avoid misinterpreting the results of screening tests. *J Clin Psychiatry* 2022;83:22com14513.
- 32 Rice SM, Parker AG, Mawren D, *et al*. Preliminary psychometric validation of a brief screening tool for athlete mental health among male elite athletes: the athlete psychological strain questionnaire. *Int J Sport Exerc Psychol* 2020;18:850–65.
- 33 Umemneku Chikere CM, Wilson K, Graziadio S, *et al*. Diagnostic test evaluation methodology: a systematic review of methods employed to evaluate diagnostic tests in the absence of gold standard - an update. *PLoS One* 2019;14:e0223832.
- 34 Dunn G, Pickles A, Tansella M, *et al*. Two-phase epidemiological surveys in psychiatric research. *Br J Psychiatry* 1999;174:95–100.
- 35 Gupta L, Morgan K, Gilchrist S. Does elite sport degrade sleep quality. A systematic review. *Sports Med* 2017;47:1317–33.
- 36 Walsh NP, Halson SL, Sargent C, *et al*. Sleep and the athlete: narrative review and 2021 expert consensus recommendations. *Br J Sports Med* 2021;55:356–68.
- 37 O'Donnell S, Beaven CM, Driller MW. From pillow to podium: a review on understanding sleep for elite athletes. *Nat Sci Sleep* 2018;10:243–53.
- 38 Clemente FM, Afonso J, Costa J. *Relationships between sleep, athletic and match performance, training load, and injuries: a systematic review of soccer players*. Multidisciplinary Digital Publishing Institute, 2021.
- 39 Fang H, Tu S, Sheng J, *et al*. Depression in sleep disturbance: a review on a Bidirectional relationship, mechanisms and treatment. *J Cell Mol Med* 2019;23:2324–32.
- 40 Minty A, Minty G. The prevalence of body dysmorphic disorder in the community: a systematic review. *GPA* 2021;4:130–54.
- 41 Bjornsson AS, Didie ER, Phillips KA. Body dysmorphic disorder. *Dialogues Clin Neurosci* 2010;12:221–32.
- 42 Phillips KA, Wilhelm S, Koran LM, *et al*. Body dysmorphic disorder: some key issues for DSM-V. *Depress Anxiety* 2010;27:573–91.
- 43 Smolak L, Levine MP. *Body image disturbance and the development of eating disorders*. The Wiley Handbook of Eating, 2015: 283–96.
- 44 Mountjoy M, Sundgot-Borgen JK, Burke LM, *et al*. IOC consensus statement on relative energy deficiency in sport (RED-S): 2018 update. *Br J Sports Med* 2018;52:687–97.
- 45 Knudsen AK, Hotopf M, Skogen JC, *et al*. The health status of Nonparticipants in a population-based health study: the Hordaland health study. *Am J Epidemiol* 2010;172:1306–14.
- 46 Jacobi F, Wittchen H-U, Holting C, *et al*. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German health interview and examination survey (GHS). *Psychol Med* 2004;34:597–611.
- 47 Åkesdotter C, Kenttä G, Eloranta S, *et al*. The prevalence of mental health problems in elite athletes. *J Sci Med Sport* 2020;23:329–35.
- 48 Johansson R, Carlbring P, Heedman Å, *et al*. Depression, anxiety and their comorbidity in the Swedish general population: point prevalence and the effect on health-related quality of life. *PeerJ* 2013;1:e98.
- 49 Caspi A, Moffitt TE. All for one and one for all: mental disorders in one dimension. *Am J Psychiatry* 2018;175:831–44.
- 50 Goutteborge V, Bindra A, Blauwet C, *et al*. International Olympic Committee (IOC) sport mental health assessment tool 1 (SMHAT-1) and sport mental health recognition tool 1 (SMHRT-1): towards better support of athletes' mental health. *Br J Sports Med* 2021;55:30–7.

**Appendix 1:** Information about the different psychiatric instruments used in this study.

Name of instrument	Comments	Ref.
Hopkins Symptoms Check List – 10-item version (HSCL-10)	The 10-items version of HSCL (HSCL-10) is a reliable assessment of symptoms of depression and anxiety. When applying a cut-off at 1.85 the instrument has been shown to have high sensitivity (89%) and specificity (98%). The positive predictive value (PPV) and negative predictive value (NPV) has also been shown to be satisfactory (PPV=87%, NPV=99%). HSCL-10 is widely used in research and clinical settings in Norway and elsewhere. Cronbach`s Alpha in our study was .859.	(1-7)
Bergen Insomnia Scale (BIS)	BIS comprises six items that assesses symptoms of insomnia based on the insomnia criteria found in the Diagnostic and Statistical Manual of Mental Disorders-IV-TR. It is used both in research and in clinical work. In our study Cronbach`s Alpha was .783.	(8, 9)
The Eating Disorder Examination – Questionnaire Short (EDE-QS)	The Eating Disorder Examination–Questionnaire (EDE-Q) is a self-report version of the Eating Disorder Examination (EDE), which is a structured clinical interview widely used for measuring eating disorders. The short version of EDE-Q (EDE-QS) consist of 12 items. EDE-QS has shown high internal consistency (Cronbach`s alpha = .913) and it is highly correlated with the original EDE-Q ( $r = .91$ for people without ED; $r = .82$ for people with ED). An “at-risk score” of 15 has shown good positive predictive value, as well as the best trade-off between sensitivity (.83) and specificity (.85). Cronbach`s Alpha in our study was .874.	(10-13)
Canadian Problem Gambling Index (CPGI)	CPGI has demonstrated strong psychometric properties and is appropriate for use in both clinical and non-clinical populations. It has been used in research in Norway (see English abstract in Pallesen et al., 2020) and elsewhere. In our study the Cronbach`s Alpha was .815.	(14-17)
The Alcohol Use Disorders Identification Test – Consumption (AUDIT-C)	The AUDIT-C is an effective short self-report questionnaire screening for alcohol misuse. It has been used in research on different populations in Norway. There have been some discussions where the cut-off score/at-risk score should be. In our study we decided to follow the recommendations from “Norwegian National Advisory Unit on Concurrent Substance Abuse and Mental Health Disorders”: <a href="https://rop.no/kartleggingsverktoey/audit-cl">https://rop.no/kartleggingsverktoey/audit-cl</a> (in Norwegian only).	(18-21)
Drug Use Disorders Identification Test (DUDIT)	DUDIT is a brief self-report questionnaire to identify individuals with drug problems, and it is used in research ( <a href="https://www.emcdda.europa.eu/drugs-library/drug-use-disorders-identification-test-dudit">https://www.emcdda.europa.eu/drugs-library/drug-use-disorders-identification-test-dudit</a> Cronbach`s alpha is generally > .90, but some studies also show a lower Cronbach`s alpha (.80). It has shown to have acceptable sensitivity-score (90% for both DSM-4 and ICD-10) and specificity-scores 78% (DSM-4) and 88% (ICD-10).	(22, 23)

**References:**

1. Schmalbach B, Zenger M, Tibubos AN, Kliem S, Petrowski K, Brähler E. Psychometric Properties of Two Brief Versions of the Hopkins Symptom Checklist: HSCL-5 and HSCL-10. *Assessment*. 2021;28(2):617-31.
2. Finbråten HS, Kleppang AL, Steigen AM. Using the Rasch measurement theory to assess the psychometric properties of the Hopkins Symptom Checklist-10 in adolescents. *Health and Quality of Life Outcomes*. 2021;19(1):248.
3. Grasdalsmoen M, Clarsen BM, Sivertsen B. Mental health in elite athletes: exploring the link between training volume and mental health problems in Norwegian college and university students. *Frontiers in Sports and Active Living*. 2022;10.
4. Lien IA, Bolstad I, Lien L, Bramness JG. Screening for depression in patients in treatment for alcohol use disorder using the Beck Depression Inventory-II and the Hopkins Symptom Checklist-10. *Psychiatry Research*. 2022;308:114363.
5. Finne LB, Christensen JO, Knardahl S. Hopkins Symptom Checklist-10--Norwegian Version. *PLoS ONE*.
6. Aye WT, Lien L, Stigum H, Schei B, Sundby J, Bjertness E. Domestic violence victimisation and its association with mental distress: a cross-sectional study of the Yangon Region, Myanmar. *BMJ Open*. 2020;10(9):e037936.
7. Strand BH, Dalgard OS, Tambs K, Rognerud M. Measuring the mental health status of the Norwegian population: a comparison of the instruments SCL-25, SCL-10, SCL-5 and MHI-5 (SF-36). *Nordic journal of psychiatry*. 2003;57(2):113-8.
8. Pallesen S, Bjorvatn B, Nordhus IH, Sivertsen B, Hjørnevik M, Morin CM. A New Scale for Measuring Insomnia: The Bergen Insomnia Scale. *Perceptual and Motor Skills*. 2008;107(3):691-706.
9. Kallestad H, Veda Ø, Scott J, Morken G, Pallesen S, Harvey AG, et al. Overcoming insomnia: protocol for a large-scale randomised controlled trial of online cognitive behaviour therapy for insomnia compared with online patient education about sleep. *BMJ open*. 2018;8(8):e025152.
10. Rand-Giovannetti D, Cicero DC, Mond JM, Latner JD. Psychometric Properties of the Eating Disorder Examination–Questionnaire (EDE-Q): A Confirmatory Factor Analysis and Assessment of Measurement Invariance by Sex. *Assessment*. 2017;27(1):164-77.
11. Gideon N, Hawkes N, Mond J, Saunders R, Tchanturia K, Serpell L. Development and Psychometric Validation of the EDE-QS, a 12 Item Short Form of the Eating Disorder Examination Questionnaire (EDE-Q). *PLOS ONE*. 2016;11(5):e0152744.
12. Prnjak K, Mitchison D, Griffiths S, Mond J, Gideon N, Serpell L, et al. Further development of the 12-item EDE-QS: identifying a cut-off for screening purposes. *BMC psychiatry*. 2020;20:1-7.
13. Lichtenstein MB, Haastrup L, Johansen KK, Bindzus JB, Larsen PV, Støving RK, et al. Validation of the eating disorder examination questionnaire in danish eating disorder patients and athletes. *Journal of Clinical Medicine*. 2021;10(17):3976.
14. Cripps E, Psych C, Korman L, Collins J. An Examination Of The Psychometric Properties Of The CPGI In Applied Research (OPGRC# 2328) Final Report–2007.
15. Pallesen S, Mentzoni RA, Torsheim T, Erevik EK, Molde H, Morken AM. Omfang av penge-og dataspillproblemer i Norge 2019. 2020.
16. Griffiths M. Problem gambling in Europe: what do we know? *Casino & Gaming International*. 2010;6(2):81-4.
17. Strømme R, Børstad KH, Rø AE, Erevik EK, Sagoe D, Chegeni R, et al. The Relationship Between Gambling Problems and the Five-Factor Model of Personality: A Systematic Review and Meta-Analysis. *Frontiers in psychiatry*. 2021;12:740235.
18. Hilde P, Ingeborg R, Anne B. Are short AUDIT screeners effective in identifying unhealthy drinking of varying severity? A prison population study. *Drug and Alcohol Dependence*. 2021;229:109153.

19. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Arch Intern Med.* 1998;158(16):1789-95.
20. Aalto M, Alho H, Halme JT, Seppä K. AUDIT and its abbreviated versions in detecting heavy and binge drinking in a general population survey. *Drug and Alcohol Dependence.* 2009;103(1):25-9.
21. Liskola J, Haravuori H, Lindberg N, Kiviruusu O, Niemelä S, Karlsson L, et al. The predictive capacity of AUDIT and AUDIT-C among adolescents in a one-year follow-up study. *Drug and Alcohol Dependence.* 2021;218:108424.
22. Hildebrand M. The Psychometric Properties of the Drug Use Disorders Identification Test (DUDIT): A Review of Recent Research. *Journal of Substance Abuse Treatment.* 2015;53:52-9.
23. Berman AH, Bergman H, Palmstierna T, Schlyter F. Evaluation of the Drug Use Disorders Identification Test (DUDIT) in criminal justice and detoxification settings and in a Swedish population sample. *European addiction research.* 2005;11(1):22-31.

**Appendix 2:** "At risk-scores" from the psychiatric instruments and number of athletes with the different "at risk-scores".

No of instruments	Psychiatric instrument (self-report)	n	%
1	AUDIT-C	28	26.42
1	BIS	15	14.15
1	HSCL-10	≤ 5	≤ 4.72
1	CPGI	≤ 5	≤ 4.72
2	BIS + AUDIT-C	18	16.98
2	HSCL-10 + BIS	≤ 5	≤ 4.72
2	HSCL-10 + AUDIT-C	≤ 5	≤ 4.72
2	EDE-QS + AUDIT-C	≤ 5	≤ 4.72
2	CPGI + AUDIT-C	≤ 5	≤ 4.72
2	BIS + EDE-QS	≤ 5	≤ 4.72
3	HSCL-10 + BIS + AUDIT-C	≤ 5	≤ 4.72
3	BIS + EDE-QS + AUDIT-C	≤ 5	≤ 4.72
3	BIS + CPGI + AUDIT-C	≤ 5	≤ 4.72
3	HSCL-10 + EDE-QS + AUDIT-C	≤ 5	≤ 4.72
4	HSCL-10 + BIS + EDE-QS + AUDIT-C	≤ 5	≤ 4.72
4	HSCL-10 + BIS + CPGI + AUDIT-C	≤ 5	≤ 4.72
4	HSCL-10 + BIS + AUDIT-C + DUDIT	≤ 5	≤ 4.72
	<b>Total</b>	<b>106</b>	<b>100</b>