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Depressive symptoms in high-performance athletes and non-athletes: A comparative meta-analysis

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Abstract

Objective: To assess whether a difference exists in prevalence of mild or more severe depressive symptoms between high-performance athletes and non-athletes.

Design: Comparative odds-ratio meta-analysis.

Data sources: We searched PSYCHINFO, PUBMED, MEDLINE, CINHAL, SPORTDiscus, and Google Scholar as well as the reference lists of reviews of mental health issues in high-performance athletes.

Eligibility: We included studies that compared high-performance athletes and non-athletes, included a validated measure of depressive symptoms, and included the prevalence of individuals who indicated at least mild depressive symptoms.

Results: Five articles reporting data from 1545 high-performance athletes and 1811 non-athletes were examined. A comparative odds-ratio meta-analysis found high-performance athletes were no more likely than non-athletes to report mild or more severe depressive symptoms (OR=1.15, 95% CI=.954, 1.383, p=.145). Male high-performance athletes (n=940) were no more likely than male non-athletes (n=605) to report mild or more severe depressive symptoms (OR=1.17, 95% CI=.839, 1.616, p=.362). For females, high-performance athletes (n=948) were no more likely than non-athletes (n=605) to report mild or more severe depressive symptoms (OR=1.11, 95% CI=.846, 1.442, p=.464). Overall, male high-performance athletes (n=874) were 52% less likely to report mild or more severe depressive symptoms than female high-performance athletes (n=705) (OR=.48, 95% CI=.369, .621, p<.001).

Summary/conclusions: High-performance athletes were just as likely as non-athletes to report depressive symptoms. Researchers need to move beyond self-report measures of depressive symptoms and examine the prevalence of clinically diagnosed depressive disorders in athletes.

Key words: mental health, depressive symptoms, elite athletes, meta analysis

What is already known?

High-performance athletes face unique stressors in training and competition that predispose them to mental health problems, like depressive symptoms.

It is hypothesized that being exposed to stressful environments may increase the likelihood high-performance athletes may report mild or more severe depressive symptoms than non-athletes.

What are the new findings?

Female high-performance athletes were just as likely to report mild or more severe depressive symptoms as female non-athletes.

Male high-performance athletes were just as likely report mild or more severe depressive symptoms as male non-athletes.

Male high-performance athletes were 52% less likely to report mild or more severe depressive symptoms than female high-performance athletes.

Depressive symptoms in high-performance athletes and non-athletes: A comparative meta-analysis

INTRODUCTION

Recent research has indicated that high-performance athletes are at risk for mental health problems.[1] Researchers have pointed to several unique stressors and challenges that high-performance athletes face that may partially explain mental health problems, like depression and anxiety, in this population. Such unique challenges and stressors include demands of competition and training,[2, 3] as well as dealing with injury and recovery.[4] Additionally, some high-performance athletes are also concerned with body image, especially amongst those who compete in aesthetic sports such as diving and gymnastics, which may result in eating disorders and substance use.[4] Research has also shown that concerns with retirement, especially when brought on suddenly and unexpectedly, leave high-performance athletes feeling vulnerable and depressed.[5, 6]

There are several reasons why high-performance athletes may wish to not disclose their mental health status and seek support. As found in the general population, athletes fear dealing with the stigma associated with mental illness and the consequences that stem from it.[4, 7, 8] Perhaps most pertinently, athletes do not wish to disrupt their athletic careers.[9] As a result, many athletes may decide to stay silent about their mental health and not receive the support and treatment that may be necessary. That being said, some high-profile athletes have disclosed mental health challenges and illnesses as part of consciousness raising exercises, although, these are predominately retired athletes. Ultimately, non-disclosure may mean that mental health

problems, especially depression, amongst high-performance athletes may be far more prevalent than what current research findings show.[8] However, given mental illness non-disclosure amongst the general population, it is not possible to say that non-disclosure affects high-performance athletes more than those in the general population and that high-performance athletes would be less likely to report symptoms that may be indicative of mental illness. In fact, few direct comparisons between high-performance athletes and the general population have been made. Although several recent narrative reviews have examined depression in high-performance athletes,[10-12] no systematic approaches to examine the literature have been taken. Furthermore, no meta-analytic approaches have been made to directly compare prevalence rates of self-reported depressive symptoms amongst high-performance athletes and non-athletes. As a result, the purpose of this meta-analysis was to directly compare high-performance athletes and non-athletes with respect to prevalence of reporting mild or more severe depressive symptoms as measured by validated measures. Findings will help illustrate if high-performance athletes are more likely to report depressive symptoms and if additional support strategies are necessary with this population.

METHODS

To ensure transparency and comprehensive reporting of the methods and results, this meta-analysis adhered to the PRISMA statement.[13]

Search Strategy and Selection Criteria

To identify appropriate studies, published work and grey literature was examined in August 2016. No limits were imposed on study types or study dates while grey literature included program evaluations, reports, book chapters, and reviews. Grey literature was used primarily to identify additional eligible studies. The following databases were searched: PSYCHINFO, PUBMED, MEDLINE, CINHAL, and SPORTDiscus. Search terms for PSYCHINFO, MEDLINE, CINHAL, and SPORTDiscus included: "elite athlete" AND "dep*"; "elite sport" AND "dep*". For searches in PUBMED, we used the following MeSH terms: "depression", "depressive disorders", "athletes", and "sports". A hand search of the reference lists of identified literature was conducted, including a hand search of recent reviews of mental illness in high-performance athletes. Google Scholar was also searched using the same key words to locate additional relevant studies.

For this review we focused specifically on depressive symptoms as measured by a validated measure. Following Swan et al.,[14] the term "high performance athlete" was equated to "elite athletes" as defined on a continuum ranging from semi-elite (e.g., participating in high performance youth development programs, competitive level college sports, programs below top level leagues) to world-class elite (e.g., participating and winning consistently at the Olympics or other world-stage events). Other classifications included competitive elite (e.g., participating regularly at highest level competitions) and successful elite (e.g., participating regularly at highest level competitions and experiencing infrequent success). Non-athletes were defined as individuals who were not engaged in any sports at a semi-elite, competitive elite, successful elite, or world-class elite level. Ultimately, studies that met the following inclusion criteria were reported in the review:

1) published in full in English;

2) compared high-performance athletes and non-athletes;

3) included a validated measure of depressive symptoms; and

4) included the prevalence of individuals who indicated at least mild depressive symptoms.

Studies were excluded if they did not include a control sample of non-athletes, did not report depressive symptoms using a validated measure of depressive symptoms, or did not report the number of individuals who indicated symptom severity using a validated measure of depressive symptoms. Where studies did not report fully on depressive symptoms, the corresponding author of the study was contacted to obtain this information. Two reviewers (PG and KG) screened the articles independently to assess their eligibility. The reviewers met to confirm study eligibility and any discrepancies between the authors were resolved through discussion until an agreement was reached.

Data extraction and analysis

Data extraction was conducted by two of the study authors independently (PG and KG). The authors then met to ensure all appropriate data was extracted. A systematic tool was designed and used to facilitate data extraction of the following information:

1) Year of publication, country, sample size, recruitment strategy, age, sex, level of high-performance athleticism, non-athlete population, type of sport, and study type.

2) Depressive symptoms: i) scale used and data collection methods, and ii) and prevalence of mild or more severe depressive symptoms. Identical data was extracted for the non-athlete control samples.

The primary outcome was the overall prevalence of at least mild or more severe depressive symptoms in high-performance athletes and non-athletes, as assessed with validated measures.

Statistical Analyses

All statistical analysis was conducted in OpenMetaAnalyst.[15] Random-effects models were applied to all meta-analyses in order to account for heterogeneity.[16]

The proportions of high-performance athletes and non-athletes indicating at least mild depressive symptoms were pooled across all studies reporting this variable, in order to calculate a weighted estimate with 95% confidence intervals. Prevalence of at least mild depressive symptoms in high-performance athletes and non-athletes were reported using odds-ratio meta-analysis, with non-athletes used as the reference group. A subgroup analysis of sex differences was also conducted, with females used as the reference group. Specifically, a comparative odds-ratio meta-analysis examined depressive symptoms between males and females in both high-performance athletes and non-athletes. Variance between studies was assessed using Cochran's Q and reported as I^2. Visual inspection of funnel-plots assessed the degree of potential publication bias.

Risk of Bias

A 10-item risk of bias in prevalence studies tool was used to assess the internal and external validity of each study.[17] Specifically, the risk of bias assessment provided an overview of the main methodological characteristics of the reported studies. Two study authors (PG and KG)

independently assessed each study for risk of bias. The overall agreement between the study authors was considered excellent (Kappa statistic = 0.90).

RESULTS

The PRISMA search process is presented in Figure 1. The initial database search returned 855 articles and a hand search identified an additional 17 articles. Of the 872 articles, 193 duplicates were removed and 679 articles were screened. In total, 25 full-text articles were assessed for eligibility and twenty were excluded for the following reasons: having no non-athlete comparison group (n=15),[6, 18-31] no reported prevalence of depressive symptoms (n=4),[32-35] and no measure of depressive symptoms (n=1).[36] A list of full-text excluded articles is presented in Table 1.

In total, five articles were included in this review, reporting data from 1545 high-performance athletes and 1811 non-athletes.[37-41] Ages for high-performance athletes ranged from 12 to 41 years and 54.0% of the athletic participants were female. Studies were conducted in Iran, Germany, Switzerland, and USA (n=2). All studies were cross-sectional and used validated measures of depressive symptoms. Validated measures included the Beck-Depression Inventory-II,[42] Center for Epidemiological Studies Depression Scale,[43] Composite International Diagnostic-Screener,[44] and Depression subscale of the Scales of the Personality Assessment Inventory.[45] Study characteristics are detailed in Table 2.

The included studies showed to be of low risk for bias for prevalence studies, ranking highly in both overall measures of internal and external validity. Risk of bias results can be seen

in Table 3. A visual inspection of a generated funnel plot revealed no publication bias.[46] The publication bias funnel plot can be seen in Figure 2.

Depressive Symptoms Prevalence Rates

Prevalence rates for mild or more severe depressive symptoms were reported by all studies. Rates of mild or more severe depressive symptoms ranged from 3.7% [41] to 26.7% [38] for high-performance athlete males and 9.8% [41] to 36.5% [37] for high-performance athlete females. For non-athletes, rates ranged from 7.6% [41] to 34.4% [38] for males and 6.1% [41] to 42.5% [38] for females. A comparative odds-ratio meta-analysis found that high-performance athletes (n=1545) were no more likely than non-athletes (n=1811) to report mild or more severe depressive symptoms (OR=1.15, 95% CI=.954, 1.383, p=.145). There was no between study heterogeneity (p=.453; I^2=0%) (Figure 3.). When sex differences were examined, a comparative odds-ratio meta-analysis found that male high-performance athletes (n=940) were no more likely than male non-athletes (n=863) to report mild or more severe depressive symptoms (OR=1.17, 95% CI=.839, 1.616, p=.362). There was negligible heterogeneity between studies (p=.276; I^2=21.71%) (Figure 4.). For females, a comparative odds-ratio meta-analysis found that high-performance athletes (n=948) were no more likely than non-athletes (n=605) to report mild or more severe depressive symptoms (OR=1.11, 95% CI=.846, 1.442, p=.464). There was no between study heterogeneity (p=.518; I^2=0%) (Figure 5.). Overall, male high-performance athletes (n=874) were 52% less likely to report mild or more severe depressive symptoms than female high-performance athletes (n=605) (OR=.48, 95% CI=.369, .621, p<.001). There was no between study heterogeneity (p=.547; I^2=0%) (Figure 6). For non-athletes, a comparative odds-

ratio meta-analysis found that males (n=812) were 42% less likely to report mild or more severe depressive symptoms than females (n=948) (OR=.58, 95% CI=.350, .977, p=.040). There was substantial heterogeneity (p=.024; I^2=68.14%) (Figure 7).

DISCUSSION

The purpose of this meta-analysis was to compare high-performance athletes and non-athletes with respect to reporting of mild or more severe depressive symptoms. Results from this meta-analysis show that high-performance athletes and non-athletes do not differ with respect to reporting mild or more severe depressive symptoms. Female high-performance athletes were twice as likely to report mild or more severe depressive symptoms than male high-performance athletes. This is the first meta-analysis to aggregate comparative findings for depressive symptoms between high-performance athletes and comparative samples of non-athletes.

Findings from this meta-analysis are in support of previous findings from other reviews and studies that have showed similar levels of prevalence for reporting depressive symptoms between high-performance athletes and non-athletes.[10, 12] Ultimately, results show that high-performance athletes were just as likely as non-athletes to report depressive symptoms. Previous research does state that due to stigma surrounding depression, high-performance athletes may try to ignore or suppress depressive symptoms and may not wish to seek help from sports psychologists and other mental health specialists.[47] Given that high-performance athletes may be more skilled at or have more sophisticated training opportunities to develop mental toughness skills; which are defined as a set of mental attributes that allow individuals to cope with stressful situations and more consistently remain determined, focused, confident, and in psychological control;[48] one may speculate that elite athletes may not report depressive symptoms by either

remaining, or seeking to appear, mentally tough. After all, to report depressive symptoms may be perceived as an admission of mental weakness, which may ultimately provide an opponent an advantage. Unfortunately, this perception of mental weakness would only perpetuate the negative attitudes associated with mental illness in sport and prevent athletes from seeking help. Equally, non-athletes may choose to ignore, suppress, and not seek help for depressive symptoms for similar stigma related reasons as well, yet do not have access to sophisticated training opportunities to develop mental toughness skills. As such, to further and better investigate the prevalence of depressive symptoms in both populations, data from clinical diagnoses in the form of structured clinical interviews rather than self-reported measures is necessary.

Although no differences were seen between athletes and non-athletes, findings from this meta-analysis confirm that female athletes were more likely to report depressive symptoms than male athletes.[31, 41, 49] The two-fold increased risk for depressive symptoms in high-performance athlete females found in this meta-analysis is similar to what has been found in non-athletes.[50] It is believed that this phenomenon is the result of many different and complicated social and psychological factors, including adverse experiences in childhood and upbringing, sociocultural roles and adverse experiences (e.g., greater likelihood of victimization related to sexual harassment, chronic everyday burdens related to social status), as well as psychological attributes related to stress and coping (e.g., negative self-concept, inward focus on feelings).[51, 52] Strategies should be designed to render more support to female athletes in terms of understanding and acknowledging depressive symptoms as well as seeking help. Additionally, it must be stressed that this study focused on self-reported measures of depressive symptoms. Therefore, findings indicate that female athletes are more likely than male athletes to report their

depressive symptoms rather than have a higher prevalence of depressive symptoms per se. Research that further helps address environmental and cultural factors, particularly gendered attitudes and values, that shape reporting behaviours is urgently required.

Due to the limited number of included studies, mild or more severe depressive symptom prevalence reporting was not examined in different sports. Future research should explore different individual and team sports as stressors, levels of responsibility, and rates of injury, like concussions, vary greatly.[25] Although Wolanin and colleagues [49] showed differences in depressive symptoms with athletes involved in track and field and cheerleading carrying the greatest risk amongst high-performance student athletes, these findings are not consistent with previous research conducted by Schaal et al..[28] Additionally, other determinants of depressive symptoms may wish to be further explored, including various demographic variables (e.g., age, race, relationship status, sexuality), physical health variables (e.g., injuries, surgeries), mental health variables (e.g., stress, self-esteem), and socio-cultural elements (e.g., social connectedness, support structures, mental toughness).

Despite a robust search and evaluation of included studies, a number of limitations with this meta-analysis must be pointed out. First, efforts were made to reach study authors by email for additional information about depressive symptom prevalence. Such information would have expanded the number of eligible studies and provided a more robust understanding of comparing depressive symptom prevalence between high-performance athletes and non-athletes. Ultimately, a small number of studies met eligibility criteria and were included in the meta-analysis. This potentially limits the generalizability of our results. Second, most included studies examined student high-performance athletes and student non-athletes. Further comparative research is

needed with professional and world-class high-performance athletes and non-student populations. Previous research has found that students tend to report higher rates of depressive symptoms than those in the general population and this may potentially skew results indicating that high-performance athletes have much higher rates of mental health problems when compared to the non-athletes.[53] Third, four different validated and reliable measures of depressive symptoms were used in this meta-analysis. For consistency and easy comparability, researchers may wish to choose to use one validated and reliable measure that has been used previously, such as the Center for Epidemiological Studies Depression Scale.[44] Fourth, we excluded unpublished and non-English language articles which exposes the current meta-analysis to publication and language biases. Lastly, each of the included studies is based on self-report measures of depressive symptoms. As such only prevalence rates of depressive symptoms are reported and not clinical diagnoses of depressive disorders. Future research should consider incorporating the use of structured clinical interviews and examine the prevalence rates of clinical diagnoses of depressive disorders. Researchers should also make every effort to follow rigorous standards in reporting in full their results as to minimize publication bias.

Overall, the results of this meta-analysis show that high-performance athletes were just as likely to report depressive symptoms as non-athletes and female high-performance athletes were twice as likely as male high-performance athletes to report depressive symptoms. Given the limitations of self-reporting depressive symptoms, researchers should aim to use structured clinical interviews in the future to examine prevalence of depressive symptoms in high-performance athletes.

Figure 1. PRIMSA flow diagram.

<Insert Figure here>

Table 1. Full text articles excluded with reasons

Excluded studies	Reason for exclusion
Gouttebarge et al. (2015)[18]	No non-athlete group comparison
Gulliver et al. (2015) [19]	No non-athlete group comparison
Guskiewicz et al. (2007) [20]	No non-athlete group comparison
Hammond et al. (2013) [21]	No non-athlete group comparison
Hart et al. (2013) [22]	No non-athlete group comparison
Kerr et al. (2012) [23]	No non-athlete group comparison
Leddy et al. (1994) [24]	No non-athlete group comparison
Appaneal et al. (2009) [25]	No non-athlete group comparison
Nixdorf et al. (2013) [26]	No non-athlete group comparison
Nixdorf et al. (2016) [27]	No non-athlete group comparison
Schaal et al. (2011) [28]	No non-athlete group comparison
Strain et al. (2013) [29]	No non-athlete group comparison
Weigand et al. (2013) [30]	No non-athlete group comparison
Wippert & Wippert (2010) [6]	No non-athlete group comparison
Yang et al. (2007) [31]	No non-athlete group comparison
Armstrong & Oomen-Early (2009) [32]	No prevalence of depressive symptoms
Backmand et al. (2005) [33]	No prevalence of depressive symptoms
Gerber et al. (2011) [34]	No prevalence of depressive symptoms
Mohammadi et al. (2012) [35]	
Brettschneider (1999) [36]	No depressive symptoms measure

Table 2. Summary of included studies

Study and location	Sample size	Recruitment and incentives to participate	Age of high-performance athletes	Level of 'high-performance' athleticism	Non-athlete population	Type of Sport	Depressive symptom measure and data collection	Prevalence of at least mild depressive symptoms
Brand et al., 2013; Germany	N=1218; 475-480 high-performance athletes male, 249-251 non-athlete male; 297-301 high-performance athletes female, 180-181 non-athlete female	Through school enrollment. No information reported about incentives.	Range 12-15 years	High-performance student athletes	Students who attended schools "showing no extraordinary form of sport programming"	Artistic gymnastics, boxing, canoe/kayak, cycling, handball, judo, modern pentathlon, rowing, shooting, soccer, swimming, track and field athletics, triathlon, volleyball, weightlifting, wrestling	Composite International Diagnostic-Screener.[27] Questionnaires administered by schoolteachers.	High-performance athletes male = 19.3%, non-athlete male = 18.7%; high-performance athlete female = 36.5%, non-athletes female = 42.2%
Ghaedi et	N=340;	Through	M=21.45	Athlete	Non-athlete	Unknown	Beck-	High-

al., 2014; Iran	90 high-performance athletes male, 90 non-athlete male; 80 high-performance athlete female, 80 non-athlete female	university enrollment. No information reported about incentives.	years (SD=1.66)	undergraduate students	college students		Depression Inventory-II,[25] scores 11 or higher were considered clinically significant. Questionnaires administered in two departments of a private university.	performance athletes male = 26.7%, non-athlete male = 34.4%; high-performance athlete female = 31.3%, non-athletes female = 42.5%
Junge & Feddermann-Demont, 2016; Switzerland	N=1300; 182 high-performance athletes male, 73 U-21 high-performance	Through the Swiss Concussion Project. No information reported about incentives.	M=24.81 years (SD=2.27) (high-performance males) M=18.35 years (SD=1.18) (U-21) M=20.95	First league and U-21	General population in Germany, 18-92 years of age	Football (soccer)	Center for Epidemiological Studies Depression Scale,[26] scores 16 or higher were considered clinically significant.	High-performance athletes male = 6.6%, U-21 athlete male = 15.1%, non-athlete

	athletes, 394 non-athlete male; 177 high-performance athlete female, 474 non-athlete female		years (SD=3.76) (high-performance females)				Questionnaires administered through the Swiss Concussion Project.	male = 7.9%; high-performance athlete female = 13.0%, non-athletes female = 14.3%
Proctor & Boan-Lenzo, 2010; USA	N=117; 66 high-performance athlete male, 51 non-athlete male	Through university enrollment. No information reported about incentives.	M=20.3 years (SD=2.03); Range=18-31 years	Division-I, intercollegiate team sport athletes	Non-athlete college students	Baseball	Center for Epidemiological Studies Depression Scale,[26] scores 16 or higher were considered clinically significant. Questionnaires were administered by coaches	High-performance athletes = 15.6%, non-athlete = 29.4%

							and professors.	
Storch et al., 2005; USA	N=398; 54 high-performance athletes male, 79 non-athlete male; 51 high-performance athlete female, 214 non-athlete female	Through university enrollment. No incentives provided.	M=20.9 years (SD=3.0); Range=17-41 years	Division-I, intercollegiate team sport athletes	Non-athlete college students	Soccer, volleyball, basketball, swimming, tennis, football	Depression subscale of the Scales of the Personality Assessment Inventory,[28] scores over 32 were considered clinically significant. Questionnaires were administered by coaches and professors.	High-performance athletes male = 3.7%, non-athlete male = 7.6%; high-performance athlete female = 9.8%, non-athletes female = 6.1%

Table 3. Risk of bias assessment

	Proctor & Boan-Lenzo	Storch et al.	Brand et al.	Ghaedi et al.	Junge & Fedder mann-Demont
External validity					
1. Were the study's target populations a close representation of relevant populations in relation to relevant variables?	Yes	Yes	Yes	Yes	Yes
2. Was the sampling frame a true or close representation of the target population?	Yes	Yes	Yes	Yes	Yes
3. Was some form of random selection used to select the sample, OR was a census undertaken?	No	No	No	No	No
4. Was the likelihood of nonresponse bias minimal?	Unclear	Unclear	Unclear	Unclear	Unclear
Internal validity					
5. Were data collected directly from the subjects (as opposed to a proxy)?	Yes	Yes	Yes	Yes	Yes
6. Was an acceptable case definition used in the study?	Yes	Yes	Yes	Yes	Yes
7. Was the study instrument that measured the parameter of interest shown to have validity and reliability?	Yes	Yes	Yes	Yes	Yes
8. Was the same mode of data collection used for all subjects?	Yes	Yes	Yes	Yes	No
9. Was the length of the shortest prevalence period for the parameter of interest appropriate?	Yes	Yes	Yes	Yes	Yes
10. Were the numerator(s) and denominator(s) for the parameter of interest appropriate?	Yes	Yes	Yes	Yes	Yes

Figure 2. Publication bias funnel plot

<Insert Figure here>

Figure 3. Relative odds of mild or more severe depressive symptoms in non-athletes vs high-performance athletes

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Figure 4. Relative odds of mild or more severe depressive symptoms in non-athletes vs high-performance athletes

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Figure 5. Relative odds of mild or more severe depressive symptoms in non-athletes vs high-performance athletes

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Figure 6. Relative odds of mild or more severe depressive symptoms in high-performance athletes

<Insert Figure here>

Figure 7. Relative odds of mild or more severe depressive symptoms in non-athletes

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Competing Interests:

All authors declare no conflicts of interest.

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None.

References

1 Rice SM, Purcell R, De Silva S, et al. The mental health of elite athletes: A narrative systematic review. *Sports Med* in press.

2 Cresswell SL, Eklund RC. Athlete burnout: A longitudinal qualitative investigation. *Sport Psychol* 2007;21:1–20.

3 Peluso M, deAndrade LH. Physical activity and mental health: the association between exercise and mood. *Clinics* 2005;60:61–70.

4 Reardon CL, Factor RM. Sport psychiatry: A systematic review of diagnosis and medical treatment of mental illness in athletes. *Sports Med* 2010;40: 961–80.

5 Grove JR, Lavallee D, Gordon S. Coping with retirement from sport: The influence of athletic identity. *J Appl Sport Psychol* 1997;9:191-203. doi:10.1080/10413209708406481

6 Wippert PM, Wippert J. The effects of involuntary athletic career termination on psychological distress. *J Clin Sport Psychol* 2010;4:133-149.

7 Watson J. College student-athletes' attitudes toward help-seeking behavior and expectations of counseling services. *J Coll Student Dev* 2005;*46:*442-449. doi: 10.1353/csd.2005.0044

8 Schwenk TL. The stigmatisation and denial of mental illness in athletes. *Br J Sports Med* 2000;34:4–5.

9 Gulliver A, Griffiths KM, Christenisen H. Barriers and facilitators to mental health help-seeking for young elite athletes: a qualitative study. *BMC Psychiatry* 2012;12:157.

10 Frank R, Nixdorf I, Beckman J. Depression among elite athletes: Prevalence and psychological factors. *Deutsche Zeitschrift Für Sportmedizin* 2015;April:1-6.

11 Maurer TA, Roh JLC. Depression and Associated Negative Stressors: The Collegiate Athlete vs. Non-Athlete. *URJHS* 2015;14. www.kon.org/urc/v14/maurer.html (accessed May 13, 2016).

12 Wolanin A, Gross M, Hong E. Depression in athletes: Prevalence and risk factors. *Curr Sports Med Rep* 2015;14:56-60.

13 Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med* 2009;151:264-269.

14 Swann C, Moran A, Piggott D. *Defining elite athletes: Issues in the study of expert performance in sport psychology. Psychol Sport Exer 2014;16:*3-14.

15 Wallace BC, Schmid CH, Lau J, et al. Meta-Analyst: software for meta-analysis of binary, continuous and diagnostic data. *BMC Med Res Methodol* 2009;9:80.

16 DerSimonian R, Laird N. Meta-analysis in clinical trials. *Control Clin Trials* 1986;7*:*177-188.

17 Hoy D, Brooks P, Woolf A, et al. Assessing risk of bias in prevalence studies: modification of an existing tool and evidence of interrater agreement. *J Clin Epidemiol* 2012;65:934-939.

18 Gouttebarge V, Frings-Dresen MH, Sluiter JK. Mental and psychosocial health among current and former professional footballers. Occup Med 2015;65:190-196.

19 Gulliver A, Griffiths KM, Mackinnon A, et al. The mental health of Australian elite athletes. J Sci Med Sport 2015;18:255-261.

20 Guskiewicz KM, Marshall SW, Bailes J, et al. Recurrent concussion and risk of depression in retired professional football players. Med Sci Sports Exerc 2007;39:903-909.

21 Hammond T, Gialloreto C, Kubas H, et al. The prevalence of failure-based depression among elite athletes. Clin J Sport Med 2013;23:273-277.

22 Hart J Jr, Kraut MA, Womack KB, et al. Neuroimaging of cognitive dysfunction and

depression in aging retired national football league players: A cross-sectional study. JAMA Neurol;70:326-335.

23 Kerr ZY, Marshall SW, Harding HP Jr, et al. Nine-year risk of depression diagnosis increases with increasing self-reported concussions in retired professional football players. Am J Sports Med 2012;40:2206-2212.

24 Leddy MH, Lambert MJ, Ogles BM. Psychological consequences of athletic injury among high-level competitors. Res Q Exerc Sport 1994;65:347-54

25 Appaneal RN, Levine BR, Perna FM, et al. Measuring postinjury depression among male and female competitive athletes. *J Sport Exer Psychol* 2009;31:60-76.

26 Nixdorf I, Frank R., Hautzinger M, et al. Prevalence of depressive symptoms and correlating variables among German elite athletes. J Clin Sport Pscyh 2013;7:313-326.

27 Nixdorf I, Frank R, Beckman J. Comparison of Athletes' Proneness to Depressive Symptoms in Individual and Team Sports: Research on Psychological Mediators in Junior Elite Athletes. Front Psychol 2016;7:893.

28 Schaal K., Tafflet M, Nassif H, et al. Psychological balance in high level athletes: gender-based differences and sport specific patterns. PLoS One 2011;6: e19007.

29 Strain J, Didehbani N, Cullum CM, et al. Depressive symptoms and white matter dysfunction in retired NFL players with concussion history. Neurology 2013;81:25-32.

30 Weigand S, Cohen J, Merenstein D. Susceptibility for depression in current and retired student athletes. Sports Health;5:263-266.

31 Yang J, Peek-Asa C, Corlette JD, et al. Prevalence of and risk factors associated with symptoms of depression in competitive collegiate student athletes. *Clin J Sport Med* 2007;17:481–487

32 Armstrong S, Oomen-Early J. Social connectedness, self-esteem, and depression symptomatology among collegiate athletes versus nonathletes. *J Am Coll Health* 2009;57:521-526.

33 Bäckmand H, Kaprio J, Kujala UM, et al. Physical and psychological functioning of daily living in relation to physical activity. A longitudinal study among former elite male athletes and controls. Aging Clin Exp Res 2005;18:40-49.

34 Gerber M, Holsboer-Trachler E, Puhse U, et al. Elite sport is not an additional source of distress for adolescents with high stress levels. *Percept Mot Skills* 2011;112:581-599.

35 Mohammadi A, Kiyanib R, Araghic MR, et al. The Compare of Depression Between Athlete and Non-Athlete Employed People. *Procedia – Soc Behav Sci* 2011;30:1878-1880.

36 Brettschneider WD. Risks and opportunities: Adolescents in top-level sport—growing up with the pressures of school and training. Euro Physical Ed Rev 1999;5:121–133.

37 Brand R, Wolff W, Hoyer J. Psychological symptoms and chronic mood in representative samples of elite student-athletes, deselected student-athletes and comparison students. *School Ment Health* 2013;5:166-174.

38 Ghaedi L, Mohd Kosnin A, Mislan N. Comparison of the degree of depression betweenathletic and non- athletic undergraduate students. *Open Sci J of Educ* 2014;2:1-6.

39 Junge A, Feddermann-Demont N. Prevalence of depression and anxiety in top-level male and female football players. BMJ Open Sport Exerc Med 2016;2:e000087.

40 Proctor SL, Boan-Lenzo C. Prevalence of depressive symptoms in male intercollegiate student-athletes and nonathletes. *J Clin Sport Psychol 2010;*4:204-220.

41 Storch EA, Storch JB, Killiany EM, et al. Self-Reported Psychopathology in Athletes: A Comparison of Intercollegiate Student-Athletes and Non-Athletes. *J Sport Behav* 2005;28:86-98.

42 Beck AT, Steer RA, Brown GK. Beck Depression Inventory—Second Edition Manual. San Antonio, TX: The Psychological Corporation 1996.

43 Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Appl Psychol Meas* 1977;*1*:385-401.

44 Wittchen HU, Höfler M, Gander F, et al. Screening for mental disorders: Performance of the Composite International Diagnostic-Screener (CID-S). *Int J Medod Psych* 1999;8:59–70.

45 Morey LC. The personality Assessment Inventory: Professional manual. Odessa, FL: Psychological Assessment Resources 1991.

46 Higgins J, Green S. Cochrane handbook for systematic reviews of interventions version 5.0.3 [updated March 2011]. The Cochrane Collaboration. 2011. http://www.cochrane-handbook.org. Accessed 31 August 2016.

47 Weigand S, Cohen J, Merenstein D. Susceptibility for depression in current and retired student athletes. *Sports Health* 2013;5:363-266.

48 Jones G, Hanton S, Connaughton D. A framework of mental toughness in the world's best performers. *Sport Psychol* 2007;21:243–264.

49 Wolanin A, Hong E, Marks D, et al. Prevalence of clinically elevated depressive symptoms in college athletes and differences by gender and sport. *Br J Sports Med* 2016;50:167-171.

50 Kessler RC, Bromet EJ. The epidemiology of depression across culture. Annu Rev Public Health 2013; 34:119-138.

51 Nolen-Hoeksema S. Gender differences in depression. Curr Dir Psychol Sci 2001;10:173-176.

52 Piccinelli, M, Wilkinson G. Gender differences in depression. *BJ Psych* 2000;177:486-492.

53 Ibrahim AK, Kelly SJ, Adams CE, et al. A systematic review of studies of depression prevalence in university students. *J Psychiatr Res* 2013;47:391-400.