

Depression in Football

Ricard Pruna^{1*} and Khatija Bahdur²

¹Medical Services FC Barcelona, FIFA Excellence Centre, Barcelona, Spain

²University of Zululand, Kwadlangezwa, South Africa

*Corresponding author: Ricard Pruna, MD, PhD, Medical Services FC Barcelona, FIFA Excellence Centre, Barcelona, Spain, Tel: +41-(0)43 222 7777; E-mail: ricard.pruna@fcbarcelona.cat

Received date: October 18, 2016; Accepted date: November 25, 2016; Published date: December 02, 2016

Copyright: © 2016 Pruna R, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Recently there has been an increase in the importance of mental health in sport professionals. Studies have shown higher levels of depression than the general population. Biological components play a big role in endogenous research, and biological reasons for depression can include the genetic components that make up the individual. But a part from that, different factors linked with the biological predisposition as injuries, overtraining, sleep disturbance, retirement, alcohol, pressure and stress highlights the importance of proper social support structures that stakeholders within the clubs have to pay attention on, and invest in.

Keywords: Depression; Sport professionals; Sleep disturbance

Introduction

Sport can be regarded as the most universal aspect of popular culture which has captivated participants and consumers from all over the world [1,2]. Football is the world's most popular sport with approximately 4.1% of the world's population plays the game professionally [3,4]. The popularity and commercialization of football has led to numerous research topics related to football. Within the medical and scientific world of football, there has been a focus on physical and performance related aspects. However, in recent years there has been an increase in the importance of mental health within the professional game. Studies have shown that elite sportspeople have higher levels of depression than the general population [5-7]. Distinctions must be made between chronic and acute depression with one being more situational and short term, while chronic depression is likely to result in major and deeper depression [8].

Depression has historically been characterized as either exogenous (reactive) or endogenous. Endogenous depression is dependent on the role of genetics in depression. Biological components play a big role in endogenous research. Exogenous depression is depression cause by external factors and life stress plays a higher role than inherited factors [9]. Research identifying the prevalence of these two types of depression in footballers has not been conducted.

The new DSM-5 includes disruptive mood dysregulation disorder, major depressive disorder, persistent depressive disorder, substance/medication-induced depressive disorder, depressive disorder due to another medical condition, and specified and unspecified depressive disorder. All of these include feel sad, empty and irritable and is accompanied by somatic and cognitive changes that may affect the person's capacity to function. They vary in duration, timing and cause. Symptoms of depression can include sadness, decreased appetite, sleep disturbances, decreased pleasure and interest in activities (including activities that the player previously enjoyed), excessive guilt, low energy, increased fatigue and decreased concentration. The symptoms of depression than result in impaired somatic, cognitive psychomotor,

social and occupational functioning usually for a minimum of two weeks. Major depression can also cause physical illness, disability and can lead to death. Somatic consequences include weight loss or gain, insomnia or hypersomnia, psychomotor agitation or retardation and fatigue or diminished energy, while cognitive include feeling worthless, inappropriate guilt, decreased concentration and indecision [8,10-12].

In 2013 FIFpro conducted a pilot study based on professional players in 5 countries. The aim of the study was to look at occurrences and the impact of mental health problems on footballers. The pilot study was followed by a full study which was based on active and retired footballers in 11 countries from 3 continents. Both studies found the prevalence of mental health problems in active and retired footballers. 38% of 607 current players and 35% of 219 former players sampled reported suffering from symptoms of depression and/or anxiety [13]. This was as high as 43% in Norway [14]. These findings show that depression is more prevalent in professional footballers than in the general population. The FIFpro study found that Sleeping disturbance (23% and 28% respectively), distress (15% and 18%) and adverse alcohol use (9% and 25%) have been found prevalent as well [13,14].

Reasons for Depression

Biology

Biological reasons for depression can include genetic and physiological components that make up the individual. The root cause of depression is linked to levels of various chemicals in the brain and a combination of genetics and brain chemistry form a foundation for developing depression [10]. 70% of all human genes are expressed in the brain, making changes or inconsistencies in genes likely to influence the manner in which the brain processes information and regulates cognitive and affective behaviors. This is despite the fact that genes do not encode for complex behaviors. Instead when variance in genes impacts at molecular and cellular level of gene and protein function, then it is more meaningful and has greater consequence brain. Long-term depression can be characterized in different regions of the brain,

with the hippocampus and cerebellum the most characterized. The complexity of depression and other mental health disorders usually means that a single gene cannot alone be the cause of the disorder [15-17].

Genes which influence healthy emotional regulation may predispose people to experience depression. The use of MRI in understanding brain structure and function has played a vital role in understanding mental health and conditions such as depression. Early onset of depression results in structural changes in the hippocampus, amygdala, striatum and frontal cortex. MRI studies of adolescences with anxiety and depression found structural anomalies in the superior temporal gyrus, ventral prefrontal cortex and amygdala. The neurotransmitter, serotonin or 5-hydroxy-tryptamine (5-HT) is involved with many CNS functions including mood.

Even transient changes in 5-HT hemostasis during early development result in changes in neural connection which can cause permanent elevation in anxiety related behaviors through adult-hood. Serotonin transporter (5-HTT) is the most important reuptake mechanism. Polymorphisms in 5-HT impacts the availability of synaptic 5-HT which is important in the functioning of the amygdala. A single nucleotide polymorphism in the region of TPH2 genes also affects amygdala function making tryptophan hydroxylase 2 also an important factor. TPH2 can limit synthesis of neuronal 5-HT. Loss of hippocampal form is consistently linked to depression. This leads to decreased levels of hippocampal brain-derived neurotrophic factor which is usually associated with decreased anxiety. Brain-derived neurotrophic factor is a critical peptide neurotrophic factor which plays a role in long term potentiation in the hippocampus with decreased plasma levels of BDNF found in patients with major depression.

Serotonin and GABA are other neurotransmitters that have been implicated in depression. They are synthesized by the decarboxylation of 5-HTP and glutamate. BDNF is regulated by serotonergic signaling. Reductions in brain Docosahexaenoic acid (DHA) content affects the pituitary gland, cortex, hippocampus, cerebellum and striatum, some of which are critical areas associated with depression [15,17-26].

Shorter leukocyte telomere length and increased mitochondrial DNA has been associated with mental health disorders such as depression and anxiety disorder and their risk factors particularly with regard to childhood adversity and psychological stress [26]. Genes related to 5-HT and hypothalamic-pituitary adrenal axis function play an important role in emotional reactivity and regulation, making it likely that they are vital in the study of depression [15].

Depression and the manner in which one expresses and perceives situations can be linked to personality type and also neuroticism which is a personality trait. The trait of neuroticism and depression share a genetic influence [15]. Other medical conditions such as epilepsy and Parkinson's are also linked with depression. This is due to the depletion of 5-HT and dopamine in epilepsy and the serotonergic and noradrenergic neurons impacted by Parkinson's [25].

The nitric oxide signaling pathway also plays a role in depression. Nitric oxide modulates the release of hypothalamic neurohormones such as corticotrophin-releasing hormone and adrenocorticotrophic hormone as corticosterone secretion. Nitric oxide signaling is also influenced by stress which causes hippocampal nitric oxide synthase (nNOS) over-expression and increases nNOS activity and nitric oxide metabolites [27].

Cognitive dysfunction can also result in lower performance which is likely to worsen the long-term outcome in players with major depressive disorder [28].

Neurogenesis, neuroplasticity (including sleep-related neuroplasticity), neuronal remodeling, neuro-immune mechanisms, neuroinflammation and neurohormonal factors, enzymes and hormones are some of the brain mechanisms that can result in depression [21,25,29].

Increased risk of cardiovascular disease is associated with depression [30].

Prolonged bouts of intense exercise decrease various immune functions and may compromise resistance to common minor illnesses [31].

Vitamin B6 is involved in the brain's production of 5-HT as well as other important neurotransmitters such as melatonin, norepinephrine and dopamine. Together with GABA, Glu, Ach and dietary tryptophan they all can contribute to depression [17,25]. Lipids also play a role in neuronal function of the brain and can influence the person's perception, mood and emotional behavior. A lack of n-3 polyunsaturated fatty acids in the brain increases depression and anxiety [23]. Testosterone impacts several monoamines which have been implemented in mental illness. By enhancing dopamine release in the mesolimbic system, testosterone can help protect against depression. Testosterone can also regulate 5-HT and serotonin function [22]. A change of the Growth hormone releasing hormone to corticotrophin releasing hormone ratio which favors CRH contributes to changes in sleep endocrine activity in depressed people [29].

There are cognitive mechanisms that also impact the manner in which a player is likely to cope with their depression. This is particularly relevant when it comes to risky behaviors such as alcohol and substance abuse [32].

Psychology

Psychological reasons for depression are all those that encompass the mindset and mental state of the person [10]. This means that a person who might have the biological predisposition to experience depression, can go their whole life without any depressive episodes due to a positive state of mind and being more conscious of their mental state and taking steps to stay mentally healthy. This can be accomplished with a strong social support network that are very effective when the player is going through negative episodes or life trauma [1,33].

Pressure and stress

Throughout their careers, footballers are exposed to intense mental demands and this can increase their susceptibility to certain mental health problems [5,34]. These pressures include normal job-related stress related to job performance, being a contributing member of a team, striving to meet individual and organization goals etc. However there are also additional pressures related to public and media scrutiny that are not limited to actions and behavior that directly relate to the job but can also include personal scrutiny. With the advances in technology and use of social media as a platform for fans and members of the public to directly interact with players and/or people close to them, the pressures on players has increased as even when out in public they might be photographed and harassed online.

Within a team sport, footballers are exposed to stresses relevant to being part of team. This includes stress related to team selection and competition to make match-day squads and the starting line-up, mistakes by teammates, mistakes by the individual and guilt over letting teammates down and aligning personal goals and recognition with team goals and recognition [35,36].

Football is a global sport that often means players need to leave their home cities and relocate to different cities, countries or continents to ply their trade. Many players often make more than one move in their careers. This means that players spend a lot of time in new cities and environments, away from their family and friends. Even when their families move with them, players still spend a lot of time away for away matches and tournaments. This can impact the social support of players and can lead to depression [37].

Travelling also has an impact on a person. International travel can involve long flights and adjusting to new languages and ways of doing things. Acute depression can occur following travel [38].

Injury

When a player suffers an injury they may experience a sense of loss which leads to common responses to grief including anger and depression. The perceived severity of the injury is likely to determine how deep the depression and anxiety may be. The depression following injury may be as a result of transient metabolic and neurochemical disturbances [39,40]. Musculoskeletal injuries can often result in shock, anger, frustration, anxiety, boredom, reduced self-esteem, fear of reinjury, and uncertainty for the future which can all lead to greater feelings of depression [3,41]. The FIFpro study also found that current professional footballers who had sustained three or more severe injuries during their career were two to nearly four times more likely to report mental health problems than professional footballers who had not suffered from severe injuries. The link between depression and injury is not related to levels of pain, showing that the other consequences of injury play a role in depression [42]. High levels of depression during an injury are also accompanied by high levels of somatic and cognitive anxiety [43,44].

The likelihood of depression in elite sport is higher in individual sports than in team sports [35]. This is because of the social support and cohesion that helps players in team sports and makes them feel less alone. However, when players are injured they are often separated from the rest of the team, they may leave the club for treatment and even when they are at the club, their schedules differ from the group. This can create a feeling of isolation and not being part of the team.

Traumatic brain injury is a risk factor for chronic depression. It is also a potential risk factor for neurodegenerative dementing disorders such as mild cognitive impairment, Alzheimer's and Parkinson's [36,45,46]. Cerebral concussions can result in depression, fatigue, irritability, confusion and general mood disturbances [39]. Footballers are at a risk for traumatic brain injury should they sustain head injuries or concussions. This can be as a result of two players knocking heads, a player hitting his head hard when he hits the ground, colliding with the goal posts, or another player kicking a player in the head. Young players are at risk for head injury from heading the ball, thus care should be taken at what age players start incorporating heading into their training, or initially use of light soft balls can be used to get technique [47].

There are differences in MRI results of sportspeople who have suffered a concussion with and without depression. Athletes with

symptoms of depression showed reduced activation in the dorsolateral prefrontal cortex and striatum. They also showed weakened deactivation in the medial frontal and temporal regions on fMRI when completing tasks associated with working memory. This was accompanied by diminished gray matter density in the parts of the brain associated with working memory [28].

Depression can also be a cause of injury. Depression reduces cognitive, somatic and psychomotor ability and functioning. This means that depressed players might be slower to react, may lack concentration and thus might perform skills at sub-par level and be likely to sustain both contact and non-contact injury [10].

Traumatic life events

Social factors including stressors change to environment and related factors also cause depression [10]. Life events that occur from childhood to present day can impact the mental health of a player this can include different situations such as maltreatment as a child, problems in adult relationships, emotional abuse from coaches, becoming a victim of crime, death or illness of a loved one etc. these social stresses unmask genetic vulnerability and susceptibility to depression. Sometimes players may have lingering doubts over decisions they might have made previously in their careers. This can include deciding which team or agent to sign a contract for, choosing not to play when injured etc. These decisions remain as active thoughts and doubts even long after the event [11,15]. Fear of failure or the moments after a performance that a footballer regards as a failure is likely to increase depression and anxiety [6]. Individuals with one or two copies of the short allele of the 5-HTT promoter polymorphism are likely to exhibit more depressive symptoms when faced with life stresses [48].

Overtraining and burnout

Players tend to be more positive and energetic at the beginning of the season but as the season goes on, they tend to get more negative feelings [49]. The physical demands placed on footballers throughout their careers are high with club seasons often lasting nine to ten months. For top players even the time away from their clubs is spent fulfilling international football obligations [34,50]. In the general population, exercise and sport participation has been linked to positive impact on mental health decreasing depression and improving moods [19,30,37,51]. However, in the football population, the intense level of activity can lead to compromise in mental health. When players are over exposed to high levels of training and matches and are unable to get enough recovery (both physical and mental), it can lead to overtraining and burnout [35]. Burnout is a syndrome of physical and emotional exhaustion that results in a reduced sense of athletic accomplishment and sport devaluation [52]. This would lead to an increased likelihood of experiencing symptoms related to depression. Balancing physical and emotional stress with proper recovery techniques is important to prevent burnout and depression in player [5,35]. Currently football is played all year, with club competitions and tournaments alternating with international tournaments and matches that are part of marketing strategies. This makes it more important for players to take some time in their days and weeks to switch off and completely detach from the game. This detachment should not only be physical but should also be mental and emotional [35]. When this does not occur it can lead to overtraining syndrome and if there is no recovery from this to total burnout.

Overtraining and burnout also have physiological consequences. The heart rate at rest and maximum heart rate are both decreased, while submaximal heart rate and VO₂ are increased. VO₂max decreases. Immune function decreases and disease susceptibility increases. Basal metabolic rate increases. Nerve excitability increases as does sympathetic nervous response. Blood serum electrolyte levels decreased, plasma lactate concentration at both submaximal and maximal exercise is decreased, levels of ammonia increase. ACTH, growth hormone and prolactin decrease as do catecholamine concentration at rest and at night. Creatine kinase increases [53,54].

Age

Half of all lifetime mental disorders in most studies start by the mid-teens and three-fourths by the mid-20s. This means that there is an overlap between age for risk of onset of mental disorders and peak competitive age for professional footballers [34,55].

Professional sport is one of the few industries where someone can be termed as a veteran by the age of 27. By the ages of 35, footballers are referred to as old men and have probably spent a few years being faced with the question of whether it is time to call it quits. Although footballers are exposed to high levels of training, they are still susceptible to the physical decrements that come with aging. While even at 35 they are much fitter than other people their age, they are still required to compete with footballers who are younger and thus the impact of aging can lead them to being slower, taking longer to recover after training and matches, increased susceptibility to injury, when compared to themselves a few years earlier [56]. This physical decline can threaten a player's career, as clubs might seek to sign younger players or result in a player not playing as much as he had previously. This can decrease the self-confidence of players and result in doubts, higher levels of anxiety and can lead to depression.

Retirement

Retiring from elite sport has significant risks to a person's psychological wellbeing making them more vulnerable to experiencing depression, anxiety, identity crisis, alcohol/substance abuse and decreased self-confidence [57].

One of the key parts of being a professional player is being physically fit and eating correct and taking care of your body. Often this is done under the supervision of medical and sport science teams which can micro manage and individualize everything from training programs to every meal plan. A big part of staying fit is also team training and playing football at a high level. Once a player retires, he may succumb to changes in the way his body looks and also the way he feels. Even players who try to maintain a high level of activity has to often deal with age-related decreases in performance (when a player retired due to age) or adapting to an injury resulting in the player not being able to keep up with such high intensities of activity. The player also has more freedom with regard to what he eats; alcohol intake etc. and this can also contribute to increases in weight which can result in body image problems and decreased feelings of self-worth [58].

The social aspect of professional football the camaraderie which often extends to keeping things light and enjoying moments off the field is a big part of team cohesion [59]. When a player retires, he may feel that he does not fit in anywhere, even if he visits the club, he is still an outsider, without understanding inside jokes and stories. Social support away from the team also changes. While a player is still playing, people might pay more interest in his thoughts, the media also

wants to know what is happening in his life both on and off the field, but when a player retires, fans and the media are more likely to move on making a player feel neglected or as if he has no value. Even friendships, both in football and away from it might experience a change in the dynamic [58].

The input that players have with regard to when they retire can also impact how well they adjust to life after playing. Players who retire due to things like not having a team or injury are more likely to feel adverse reactions such as depression, while players who had a choice with regard to the timing of their retiring will feel more positive towards to experience [57,60].

When anyone retires they are faced with the challenge of what to do next. This transition may be easier for footballers who do not have their whole identities linked to their identity of being a footballer [57]. Those who have diverse interests or have managed to separate the person they are in private from the public football persona are more likely to handle this with minimal negative consequences

Professional footballers often have basic things done for them and their lives are fully organized around their job needs [61]. When they travel someone else takes care of everything from the accommodation bookings, booking tickets, arranging transfers to and from the airport, getting visas etc. Once a player retires, he or his family is often required to take care of these tasks and they may be unfamiliar with the systems and ways of doing things. This can add to the anxiety of a player.

The FIFpro study found that retired players experienced symptoms related to depression. They found in 219 retired professional footballers 11% participated in adverse smoking behavior, 24.6% showed adverse alcohol behavior, 28.2% experiences sleep disturbances, 18% experienced distress, 35% experiences anxiety/depression and 65% showed adverse nutritional behavior. Players who had experienced any life change or trauma showed were in the higher ranges [13,14,41].

Impulsivity and risk taking

Footballers tend to be impulsive people. This helps them make decisions quicker on the field and can give them an advantage when playing. Impulse has also been linked to risky behavior and decision-making [62]. Sometimes impulsivity extends off the field and players may take more risks or engage in risky behavior. This can relate to their football at times such as when players choose to play injured, risking their bodies for their game, but can also be non-football related and link to things like over-indulgence with alcohol, not following their diets, deviant sexual behaviors, bad driving etc. [3,63]. High risk behaviors have been linked with increases in depression [64,65].

Sleep disturbance

Disturbances in sleep can be as a result of depression, but in some instances sleep disturbances actually causes depression. Poor sleep results in increases of fatigue [66]. Acute partial sleep deprivation can result in negative mood states including depression, tension, confusion and anger and decreases in energy levels [66].

Alcohol

Alcohol consumption is one of those factors that are common for many football players. But when alcohol is misused it can lead to depression. The impact of alcohol as well as players dependency on alcohol and likelihood for addiction can be linked to genetic and physiological factors [67].

Gender differences with regard to depression

Research has found that females are two times more likely to experience depression than males [68]. Female footballers also face additional challenges in their careers. More insight is needed to identify similarities and differences in causes, effect and coping mechanisms of depression in female players.

Conclusion

Approximately 10% of people with depression commit suicide. In football there are several examples of players who have succumbed to their depression. This alone highlights the importance of proper support structures and people in place to assist players in dealing with both the physical and mental symptoms related to depression. Social support and having players feel like those around them care helps the player when they are dealing with things such as injury, loss in form, bad results etc.

References

- Dima T (2015) The business model of European Football Club competitions. *Econ Finance* 23: 1245-1252.
- Tainsky S (2010) Television broadcast demand for National Football League contests. *J Sports Econ* 11: 629-640.
- Hassabi M, Mortazavi SMJ, Giti MR, Hassabi M, Mansournia MA, et al. (2010) Injury profile of a professional soccer team in the premier league of iran. *Asian J Sports Med* 1: 201-208.
- Sener I, Karapolatgil AA (2015) Rules of the game: Strategy in football industry. *Soc Behav Sci* 207: 10-19.
- Frank R, Nixdorf I, Beckmann J (2013) Depression in Elite Athletes: Prevalence and Psychological Factors. *Dtsch Z Sportmed* 64: 320-326.
- Hammond T, Gialloredo C, Kubas H, Davis HH 4th (2013) The prevalence of failure-based depression among elite athletes. *Clin J Sport Med* 23: 273-277.
- Brewer BW, Petrie TA (2014) Psychopathology in sport and exercise. In JL Van Raalte & BW Brewer (Eds), *Exploring sport and exercise psychology* (3rd edtn). American Psychological Association, Washington, DC, USA.
- Appaneal RN, Levine BR, Perna FM, Roh JL (2009) Measuring post-injury depression among male and female competitive athletes. *J Sport Exerc Psychol* 31: 60-76.
- Fukuda K (2014) Etiological classification of depression based on the enzymes of tryptophan metabolism. *BMC Psychiatry* 14: 372.
- Bader C (2014) Mind, Body and Sport: Mood disorders and depression.
- Cogan KD (1998) Putting the Clinical into sport psychology consulting. *The Psychotherapy Patient* 10: 131-143.
- Mitjans M, Arias B (2012) The genetics of depression: what information can new methodologic approaches provide? *Actas Esp Psiquiatr* 40: 70-83.
- Goutteborge VM, Aoki H, Kerkhoffs GM (2016) Prevalence and determinants of symptoms related to mental disorders in retired male professional footballers. *J Sports Med Phys Fitness* 56: 648-654.
- Goutteborge V, Aoki H, Kerkhoffs G (2015) Symptoms of Common Mental Disorders and Adverse Health Behaviours in Male Professional Soccer Players. *J Hum Kinet* 49: 277-286.
- Hariri AR, Weinberger DR (2009) Genetics of human anxiety and its disorders. *Encyclopaedia of Neuroscience* 669: 677.
- Massey PV, Bashir ZI (2007) Long-term depression: multiple forms and implications for brain function. *Trends Neurosci* 30: 176-184.
- Cohen-Woods S, Craig IW, McGuffin P (2013) The current state of play on the molecular genetics of depression. *Psychol Med* 43: 673-687.
- Aguilera M, Arias B, Wichers M, Barrantes-Vidal N, Moya N, et al. (2009). Early adversity and 5-HTT/BDNF genes: new evidence of gene-environment interactions on depressive symptoms in a general population. *Psychol Med* 39: 1425-1432.
- Carek PJ, Laibstain SE, Carek SM (2011) Exercise for the treatment of depression and anxiety. *Int J Psychiatry Med* 41: 15-28.
- Paus T, Keshavan M, Giedd JN (2008) Why do many psychiatric disorders emerge during adolescence? *Nat Rev Neurosci* 9: 947-957.
- Manning KJ (2016) Hippocampal neuroinflammation and depression: relevance to multiple sclerosis and other neuropsychiatric illnesses. *Biological Psychiatry* 80: e1-2.
- McHenry J, Carrier N, Hull E, Kabbaj M (2014) Sex differences in anxiety and depression: role of testosterone. *Front Neuroendocrinol* 35: 42-57.
- Müller CP, Reichel M, Mühle C, Rhein C, Gulbins E, et al. (2015) Brain membrane lipids in major depression and anxiety disorders. *Biochim Biophys Acta* 1851: 1052-1065.
- Pezawas L, Meyer-Lindenberg A, Drabant EM, Verchinski BA, Munoz KE, et al. (2005) 5-HTTLPR polymorphism impacts human cingulate-amygdala interactions: a genetic susceptibility mechanism for depression. *Nat Neurosci* 8: 828-834.
- Shabbir F, Patel A, Mattison C, Bose S, Krishnamohan R, et al. (2013) Effect of diet on serotonergic neurotransmission in depression. *Neurochem Int* 62: 324-329.
- Hovatta I (2015) Genetics: dynamic cellular aging markers associated with major depression. *Curr Biol* 25: R409-411.
- Joca SR, Moreira FA, Wegener G (2015) Atypical Neurotransmitters and the Neurobiology of Depression. *CNS Neurol Disord Drug Targets* 14: 1001-1011.
- Chen CM, Juan CH, Chen MH, Chang CF, Lu HJ, et al. (2016) Different forms of prefrontal theta burst stimulation for executive function of medication-resistance depression: Evidence from a randomized sham-controlled study. *Prog Neuropsychopharmacol Biol Psychiatry* 66: 35-40.
- Steiger A, Dresler M, Kluge M, Schüssler P (2013) Pathology of sleep, hormones and depression. *Pharmacopsychiatry* 46 Suppl 1: S30-35.
- Zoller RF (2007) Depression, anxiety, physical activity, and cardiovascular disease: What's the connection? *American Journal of Lifestyle Medicine* 1: 175-180.
- Gleeson M (2007) Immune function in sport and exercise. *J Appl Physiol* 103: 693-699.
- Luminet O, Uva MCS, Fantini C, Timary P (2016) The association between depression and craving in alcohol dependency is moderated by gender and by alexithymia factors. *Psychiatry Research* 239: 28-38.
- Yang J, Schaefer JT, Zhang N, Covassin T, Ding K, et al. (2014) Social support from the athletic trainer and symptoms of depression and anxiety at return to play. *J Athl Train* 49: 773-779.
- Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, et al. (2016) The Mental Health of Elite Athletes: A Narrative Systematic Review. *Sports Med* 46: 1333-1353.
- Nixdorf I, Hautzinger M, Beckmann J (2013) Prevalence of depressive symptoms and correlating variables among German Elite Athletes. *J Clin Sport Psychol* 7: 313-326.
- Roiger T, Weidauer L, Kern B (2015) A longitudinal pilot study of depressive symptoms in concussed and injured/non concussed national collegiate athletic association division I student-athletes. *J Athl Train* 50: 256-261.
- Donohue B, Chow GM, Pitts M, Loughran T, Schubert KN, et al. (2015) Piloting a family-supported approach to concurrently optimize mental health and sport performance in athletes. *Clin Case Studies* 14: 159-177.
- Fowler P, Duffield R, Vaile J (2015) Effects of simulated domestic and international air travel on sleep, performance, and recovery for team sports. *Scand J Med Sci Sports* 25: 441-451.
- Mainwaring L, Hutchison M, Camper P, Richards D (2009) Examining emotional sequelae of sport concussion. *J Clin Sport Psychol* 6: 247-274.
- Walker N, Thatcher J, Lavallee D (2007) Psychological responses to injury in competitive sport: a critical review. *J R Soc Promot Health* 127: 174-180.

41. Gouttebarga V, Backx FJ, Aoki H, Kerkhoffs GM (2015) Symptoms of Common Mental Disorders in Professional Football (Soccer) Across Five European Countries. *J Sports Sci Med* 14: 811-818.
42. Oztekin HH, Boya H, Ozcan O, Zeren B, Pinar P (2008) Pain and affective distress before and after ACL surgery: A comparison of amateur and professional male soccer players in the early postoperative period. *The Knee* 15: 368-372.
43. Olmedilla A, Ortega E, Gomez JM (2014) Influence of sports injury changes in mood and precompetitive anxiety in soccer players. *Cuadernos de Psicología del Deporte* 14: 55-62.
44. Putukian M (2016) The psychological response to injury in student athletes: a narrative review with a focus on mental health. *Br J Sports Med* 50: 145-148.
45. Guskiewicz KM, Marshall SW, Bailes J, Mccrea M, Harding Jr HP, et al. (2007) Recurrent concussion and risk of depression in retired professional football players. *Med Sci Sports Exerc* 39: 903-999.
46. Vargas G, Rabinowitz A, Meyer J, Arnett PA (2015) Predictors and prevalence of postconcussion depression symptoms in collegiate athletes. *J Athl Train* 50: 250-255.
47. Schaffer A (2015) Are young athletes risking brain damage? *MIT Technology Review* 119: 80-82.
48. Caspi A, Sugden K, Moffitt TE, Taylor A, Craig IW, et al. (2003) Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene. *Science* 301: 386-389.
49. Lovell GP, Townrow J, Thatcher R (2009) Mood stated of soccer players in the English Leagues: Reflections of an increasing workload. *Biology of Sport* 27: 83-88.
50. Reilly T, Gregson W (2006) Special populations: the referee and assistant referee. *J Sports Sci* 24: 795-801.
51. Barclay TH, Richards S, Schoffstall J, Magnuson C, McPhee C, et al. (2014) A pilot study on the effects of exercise on depression symptoms using levels of neurotransmitters and EEG as markers. *Eur J Psychol Educ Studies* 1: 30-35.
52. Hill AP, Hall HK, Appleton PR, Kozub SA (2008) Perfectionism and burnout in junior elite soccer players: The mediating influence of unconditional self-acceptance. *Psychol Sport Exerc* 9: 630-644.
53. Schmikli SL, De Vries WR, Brink MS, Backx FJG (2012) Monitoring performance, pituitary-adrenal hormones and mood profiles: how to diagnose non-functional over-reaching in male elite junior soccer players. *Br J Sports Med* 46: 1019-1023.
54. Wilmore JH, Costill DL (2004) *Physiology of sport and exercise*. (3rd edtn). Human Kinetics Publishers, Illinois, USA.
55. Kessler RC, Amminger GP, Aguilar-Gaxiola S, Alonso J, Lee S, et al. (2007) Age of onset of mental disorders: a review of recent literature. *Curr Opin Psychiatry* 20: 359-364.
56. Ronkainen NJ, Ryba TV, Nesti MS (2013) The engine just started coughing!- Limits of physical performance, aging and career continuity in elite endurance sports. *J Aging Stud* 27: 387-397.
57. Cosh S, Crabb S, Tully PJ (2015) A champion out of the pool? A discursive exploration of two Australian Olympic swimmers' transition from elite sport to retirement. *Psychol Sport Exerc* 19: 33-41.
58. Weigand S, Cohen J, Merenstein D (2013) Susceptibility for depression in current and retired student athletes. *Sports Health* 5: 263-266.
59. Gearing B (1999) Narratives of identity among former professional footballers in the United Kingdom. *J Aging Stud* 13: 43-58.
60. Erpic SC, Wylleman P, Zupancic M (2004) The effect of athletic and non-athletic factors on the sports career termination process. *Psychol Sport Exerc* 5: 45-59.
61. Schwenk TL, Gorenflo DW, Dopp RR, Hipple E (2007) Depression and pain in retired professional football players. *Med Sci Sports Exerc* 39: 599-605.
62. Llewellyn DJ, Sanchez X (2008) Individual differences and risk taking in rock climbing. *Psychol Sport Exerc* 9: 413-426.
63. Swann C, Moran A, Piggott D (2015) Defining elite athletes: Issues in the study of expert performance in sport psychology. *Psychol Sport Exerc* 16: 3-14.
64. McFarlane S (2013) Risk behaviours and adolescent depression in Jamaica. *Int J Adolesc Youth* 19: 458-467.
65. Ramrakha S, Caspi A, Dickson N, Moffitt TE, Paul C (2000) Psychiatric disorders and risky sexual behaviour in young adulthood: cross sectional study in birth cohort. *BMJ* 321: 263-266.
66. Dennis J, Dawson B, Heasman J, Rogalski B, Robey E (2016) Sleep patterns and injury occurrence in elite Australian footballers. *J Sci Med Sport* 19: 113-116.
67. Grant JD, Agrawal A, Bucholz KK, Madden PA, Pergadia ML, et al. (2009) Alcohol consumption indices of genetic risk for alcohol dependence. *Biol Psychiatry* 66: 795-800.
68. Hoshino A, Amano S, Suzuki K, Suwaa M (2016) Relationships between depression and stress factors in housework and paid work among Japanese Women. *Hong Kong J Occup Ther* 27: 35-41.