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RESEARCH ARTICLE



Interactive effects of sex and pain on elevated depressive symptoms in university student athletes

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ABSTRACT

Student athletes are a unique group that balances sporting and academic prowess with a reduction in social support when moving away from home. Thus, many studies indicate that student athletes may experience higher depressive symptoms compared to the general public, with sex, pain, and injury status reported to influence this. Therefore, this study aimed to identify whether sex, injury or pain predicts elevated depressive symptoms among student athletes and whether there are interactions between these factors. Depression scores were measured using the Center for Epidemiological Studies Depression Scale (CESD). Of 130 participants, 43% displayed depressive symptoms recorded as scoring ≥ 16 on the CESD, which is much higher than what is seen in the general public. A multiple linear regression revealed that sex ($p = .022$) and physical pain ($p = .015$) explained almost 9% of the variance in depressive symptoms ($p = .022$). Women were found to be more susceptible to experiencing depressive symptoms and there was a significant interaction between sex and pain ($p = .002$). Injury was not found to be a significant predictor ($p = .566$). Therefore, it is important to be aware of physical pain levels in women student athletes to protect their mental health regardless of whether they are injured or not. Improving our knowledge in this area can improve the support given towards student athletes that are experiencing physical pain. This may provide sports coaches with a greater insight into the well-being of their athletes and lead to improved athlete support.

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Depression; sex; physical pain; injury; student athletes

Introduction

Though there have been increased efforts to investigate depressive symptoms in student athletes in recent years, the findings in this area are still mixed. Gorczyński et al.'s (2017) meta-analysis on the topic concluded that high-performance athletes were just as likely to report depressive symptoms as non-athletes. However, depression prevalence rates for student athletes have also been shown to range from 21% in the USA (Yang et al., 2007) to 51% in the UK (Walker & Marchant, 2020) which is alarmingly higher than the

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3.8% prevalence rate found in the global population (WHO, 2022). For this reason, this area ought to be explored. Exposure to prolonged stress can lead to depression and other mood disorders (Dario et al., 2018; Seo et al., 2017) and Beiter et al. (2015) reported academic performance, pressure to succeed, and post-graduation plans as three of the main concerns for student athletes. In addition, many students live away from home leading to a reduction in social support which is thought to be a method of coping with stress and combatting depression (Cohen & Wills, 1985). With evidence that female student athletes report significantly more depressive symptoms than males (Wolanin et al., 2016), it is possible that sex could also be a potential risk factor. Moreover, sustaining physical injuries (Kay et al., 2017) and experiencing physical pain (Druckman & Rothschild, 2018) are commonplace in sport, and both are associated with elevated depressive symptoms (Putukian, 2016; Walker & Marchant, 2020; Yang et al., 2007). Coupled with the constant demands of academic and sporting prowess (McGuire et al., 2017), student athletes are therefore in a vulnerable position regarding their mental health.

Physical activity has been found to have a positive effect on mental health (Callow et al., 2020; Saxena et al., 2005). Benefits include the release of endorphins (Craft & Perna, 2004) and self-identification that provides a buffer from depression and alienation, fostering feelings of belongingness and self-worth (Branscombe & Wann, 1991). Conn (2010) also suggests that physical activity can reduce depressive symptoms even in adults without clinical depression, emphasising the importance of physical activity for maintaining optimum mental health. However, student athletes are more likely to sustain a physical injury compared with those that do not compete in sport, and this time lost from engaging in physical activity and sporting competition could exacerbate depressive symptoms. Athletes have been found to report higher levels of emotional disturbance following injury (Appaneal et al., 2009; Mainwaring et al., 2010) as well as higher emotional disturbance to those without injury (Abenza Cano et al., 2010; Kleinert et al., 2020). Athletes tend to use a variety of negative terms (anger, bitterness, confusion, depression, fear, frustration, helplessness, shock) when describing their emotions after injury (Bianco et al., 1999; Kleinert et al., 2020; Wadey et al., 2012). This helps explain why athletes who have been injured within the past 12 months are more likely to display elevated depressive symptoms than athletes who remain injury free (Brewer & Petrie, 1995). Therefore, injury as a predictor of depressed mood requires further investigation.

Sporting injuries are often accompanied by physical pain, which is also associated with increased depressive symptoms. Although sport-related bodily pain is widely accepted by athletes (Ridpath, 2008), when side-lined with an injury, physical pain can influence mood. For example, Walker and Marchant (2020) found in a study of 111 student athletes that those displaying depressive symptoms reported significantly higher scores of self-reported physical pain than those without depressive symptoms. Bodine (2018) also reported that student athletes experiencing pain and those with a high athletic identity may experience depression symptoms. This is supported with evidence of students with a higher pain intensity showing a significantly higher probability to suffer from depression in a sample of 865 German, Austrian, and Swiss student athletes (Bumann et al., 2020). With a suggested overlap between pain and Major Depressive Disorder pathways (Nekovarova et al., 2014), pain is therefore also relevant when investigating and identifying predictors of depressed mood.

Another relevant factor in depression in sport seems to be sex with women twice as likely to experience depression at some point in their lives than men (Ferrari et al., 2013; Kessler et al., 2005). A similar pattern is found in student athletes (Wolanin et al., 2016). Wolanin et al. (2016) reported that women are at 1.8 times greater risk of endorsing clinically relevant depressive symptoms than male student athletes; however, this could be because male athletes have been found to be 52% less likely to report mild or severe depressive symptoms (Gorczynski et al., 2017). With concomitant evidence that women report higher stress levels (Bayram & Bilgel, 2008), there is the possibility that enhanced stress sensitivity may influence mood behaviour and subsequent mood disorders (Hodes et al., 2017). Although there is evidence of no difference in pain severity between men and women (Rovner et al., 2017), women are more likely to accept pain and social support while men report mood disturbances and lower activity level (Fukuoka, 1999). Therefore, men and women athletes may cope with pain and injury differently which could influence depressive symptom reporting.

As student athletes may be at risk of displaying elevated depressive symptoms, it is important to better understand the process underlying this association. Physical injury resulting in time loss from sport can promote negative thinking in those absent from their routine (Smith & Milliner, 1994), and physical pain that accompanies injury can exacerbate depressive symptoms (Nekovarova et al., 2014; Walker & Marchant, 2020; Yang et al., 2007). In addition, with women often displaying higher depressive symptoms than men (Ferrari et al., 2013; Kessler et al., 2005; Wolanin et al., 2016), but having a more positive approach to dealing with physical pain (Rovner et al., 2017) the role of sex cannot be ignored. Therefore, the present study aimed to assess whether sex, injury, and physical pain are associated with elevated depressive symptoms in student athletes, and whether there are interactions between these factors. By understanding which factors are associated more strongly with elevated depressive symptoms, sports teams may be better placed to support student athletes.

Method

Participants

The present study consisted of a convenience sample of men and women student athletes, whereby participants responded to social media advertisements to express their interest in taking part. Participants were recruited via social media platforms LinkedIn, Twitter, and Facebook and attended 34 different universities in the United Kingdom. The term “student athletes” was operationalised as any individual that attends/attended university in the last 12 months who also competes/competed in sport and physical activity.

Of a total of 138 participants, five did not complete the survey and were excluded. After excluding three outliers identified by scatterplot (cases that had a standardised residual of more than 3.3 or less than -3.3; Tabachnick & Fidell, 2013), 130 were included in the final analysis. Participant ages ranged between 18 and 28 years ($M = 22.21$, $SD = 1.79$) and over half of the sample competed in their sport at an amateur level at time of participation (Sport Performance Level; Amateur, University, Semi-professional, County, National). Two-fifths (39.2%) of participants reported having sustained a physical injury in the

past 12 months, with all but one of the injured athletes reporting time lost from sport due to injury, ranging from 2 to 365 days ($M = 68.94$, $SD = 96.95$). Almost three-quarters (71.5%) reported feeling some level of physical pain at time of participation. Additional participant characteristics are provided in [Table 1](#).

The sample size was calculated using the G*Power 3.1.9.2 software. Multiple linear regression required 125 participants to provide adequate power ($\beta = 0.8$) to detect an effect size of $f^2 = 0.1$ at $\alpha = 0.05$. Additionally, Tabachnick and Fidell (2013) provide a formula for calculating sample size requirements, considering the number of independent variables: $N > 50 + 8m$ (where m = number of independent variables). Therefore, having three independent variables, requires 74 participants. Thus, the sample consisting of 130 participants satisfied the needs for multiple linear regression.

Procedure

All participants completed the study during university exam period. Measures included a General Information Questionnaire (GIQ) and the Center for Epidemiological Studies Depression Scale (CESD) completed using Qualtrics software (Qualtrics, Provo, UT). The participant information sheet was displayed on the first screen of the survey, followed by an electronic consent form. Participants were permitted to continue upon providing informed consent. The GIQ and CESD were then presented, followed by a study debrief form.

Measures

General information questionnaire (GIQ)

The General Information Questionnaire (GIQ) was designed by the researchers to record demographic variables. This tool included seven items; age, biological sex, predominant sport, performance level, mental health history operationalised as any prior diagnosed mental health disorder, sport-related injury in the past 12 months, days absent from sport due to injury and self-reported physical pain in the past week. These time

Table 1. Descriptive statistics depicting participant characteristics.

	N		N (%) Total
	Men	Women	
Sex	43	87	130
Predominant Sport			
Circuits	3	23	26(20)
Football	16	8	24(18.4)
Rugby	8	2	10(7.7)
Netball	0	10	10(7.7)
Athletics	1	7	8(6.2)
Other	15	37	52(40)
Sport Performance Level			
Amateur	21	46	67(51.5)
University	2	3	5(3.8)
Semi-professional	19	33	52(40)
County	1	1	2(1.5)
National	0	4	4(3.1)

Note: N = Number of participants, % = Percentage of total sample.

periods were selected because physical pain in the past week would likely impact mental health acutely, whereas the impact of injury may be longer lasting. An injury sustained several months ago could still influence mental health, with social factors such as not feeling part of a team or losing a position to a teammate likely to exert negative effects (Smith & Milliner, 1994). Dichotomous questions were provided for biological sex (Male/Female, *note: gender was not investigated*), mental health history (Yes/No), and injury history (Yes/No), an 11-point Likert scale was used for recording physical pain (0–10), and free-text responses were utilised for the remaining questions (age, predominant sport, sport performance level, time lost due to injury).

Center for epidemiological studies depression scale (CESD; Radloff, 1977)

Depressive symptoms were measured using the Center for Epidemiological Studies Depression Scale (CESD), a valid tool for examining university students (Radloff, 1977). The 20-item questionnaire measured the depressive symptoms that participants experienced in the past week. A four-point scale was used to rank responses: 0 “rarely or none of the time” (experienced symptoms less than once a week), 1 “some or a little of the time” (1–2 days a week), 2 “occasionally or a moderate amount of time” (3–4 days a week) and 3 “most or all of the time” (5–7 days a week). The sum of scores was calculated between 0 and 60, with a total score of ≥ 16 highlighting that an individual may be experiencing some form of depression (Husaini et al., 1980). The higher the total score produced, the more severe level of depressive symptoms. An internal consistency score of 0.92 was found in this sample, which is considered excellent (Sharma, 2016).

Ethics

All British Psychological Society (BPS) guidelines were adhered to. Furthermore, approval was gained from the Department of Psychology Research Ethics Committee (PREC) at the University of Bath. Participants were informed of the aims of the study prior to taking part, through the participant information sheet presented on the opening screen of the survey. All participants provided full informed consent via tick box options provided onscreen. Those who did not provide consent were not able to access the survey questions. An electronic copy of a debrief and referral sheet was presented at the end of the survey, reiterating the aims of the study and providing participants with information about where to seek mental health support should they need it.

Data analysis

Data analysis was conducted using IBM SPSS Statistics (Version 23). A stepwise multiple linear regression was used to address the primary research question including three independent variables (sex, injury, and physical pain). In step 1, these predictors were included to assess direct effects on depressive symptoms. Factors that were non-significant in this step were removed in step 2. Interaction terms were added for remaining factors in step 2, to explore potential effect modification.

Linearity and normality were checked by inspecting the Normal Probability Plot (P–P) of the Regression Standardised Residual and homoscedasticity was visually inspected using a scatterplot (Tabachnick & Fidell, 2013). There was no evidence of multicollinearity

and the Variation Inflation Factors (VIFs) in the present study (Sex = 1.01, Pain = 1.01, Injury = 1.19) were acceptable (Galani et al., 2011). To test for the assumption of independent errors, the Durbin-Watson statistic yielded a value of 2.17, which was acceptable (Field, 2013).

Results

Factors associated with elevated depressive symptoms

Step 1

Sex, injury status, and physical pain were entered at step 1 of the multiple linear regression, explaining 8.8% of the variance in depressive symptoms, $F(1, 127) = 5.391$, $p = .022$. Both sex, $b = .197$, $\beta = 4.281$, $SE = 1.844$, $t(127) = 2.322$, $p = .022$, and physical pain, $b = .208$, $\beta = 1.001$, $SE = .408$, $t(127) = 2.454$, $p = .015$, were found to be significant predictors of elevated CESD scores, whereas injury history was not ($p = .566$).

Step 2

Excluding injury history and adding an interaction term between remaining variables sex and physical pain was included in step two. Upon adding this term, the model now explained 12% of the variance in depressive symptoms, $F(1, 127) = 4.06$, $p = .046$. A significant interaction between sex and pain was found, $b = .736$, $\beta = 1.918$, $SE = .6$, $t(127) = 3.196$, $p = .002$. A summary of these results is presented in Table 2.

Discussion

The present study aimed to identify whether sex, injury or pain are associated with depressive symptoms among student athletes, and whether there was any interaction between these factors. Multiple regression analyses found main effects of sex and physical pain whereas injury history had no direct effect on depressive symptoms. A significant interaction effect was established between sex and pain, accounting for more variance than the main effects of sex and pain alone. This interaction suggests female athletes will likely report higher depressive symptoms when reporting less physical pain compared to their male counterparts, which may inform more tailored support given to athletes in pain. Additionally, an alarming 43% of participants displayed depressive symptoms at the

Table 2. Summary of multiple regression analysis predicting CESD scores.

Predictor Variables	B (95% CI's)	SE	β	sr	p
Step 1					
Constant	6.252 (-.218, 12.723)	3.270	–	–	.058
Sex	4.281 (.632, 7.929)	1.844	.197	.197	.022
Physical Pain	1.001 (.194, 1.808)	.408	.208	.208	.015
Injury History	-.053	–	–	-.051	.566
Step 2					
Constant	13.328 (10.863, 15.793)	1.246	–	–	.000
Sex	.012	–	–	.009	.922
Physical Pain	-2.227 (-4.414, -.041)	1.105	-.464	-.168	.046
Sex*Physical Pain	1.918 (.73, 3.105)	.600	.736	.266	.002

Step 1: Overall Model Fit, $F(1, 127) = 5.391$, $p = 0.022$ $R^2 = 0.088$.

Step 2: Overall Model Fit, $F(1, 127) = 4.06$, $p = 0.046$. $R^2 = 0.120$.

time of their participation, depicting a much higher prevalence compared with the general population (WHO, 2022).

The findings support evidence that female athletes are more likely to report depressive symptoms than male athletes (Ferrari et al., 2013; Kessler et al., 2005) and that increased physical pain is related to elevated depressive symptoms (Walker & Marchant, 2020). Social factors in the response to pain may explain pain perception differences between sexes. For example, women report more catastrophising and rumination during pain-inducing tasks (Edwards et al., 2004), and react differently to attentional strategies to mediate their pain (Keogh et al., 2000) compared to men. The higher rate of catastrophising and rumination that Edwards et al. (2004) suggest could be due to reductions in quality of performance, criticism from coaches and teammates, concentration difficulties, and the fear of losing their position to teammates (Smith & Milliner, 1994). Therefore, it may be that the coping mechanisms that female athletes adopt to these stressors differ to male athletes in a way that could exacerbate depressive symptoms.

Unfortunately, some athletes continue to play through pain to prevent letting down parents or coaches (Keese, 2020), which can result in overuse injuries that increase physical pain (Walker & Marchant, 2020) and in turn, depressive symptoms. There may be participants in this sample that did not report any injury history as they were continuing to play with overuse injuries, reporting of which tends to be poor (Keese, 2020). This makes it difficult to determine the true effect of injury history in this study because it may not capture overuse injuries, and differential reporting behaviours amongst men and women are poorly understood. There may be a misclassification of those “non-injured” that are continuing participation in their sport or whose pain may be from a source other than their previous injury such as training. This may explain how physical pain has been found to be associated with elevated depressive symptoms and injury history was not. Moreover, injury reporting is a complex, contextually-specific process which may not be easily dichotomised by biological sex, potentially diminishing its predictive capacity in our analysis.

Additionally, the level at which athletes participated may have influenced the results. Over 90% of the sample were either competing at amateur or semi-professional level when taking part in this study and therefore the conclusions are largely based on student athletes competing at these levels. Our results may signify poor monitoring of physical pain from sports coaches or poor reporting of pain from the athletes themselves. This may be due to amateur players being less likely to report pain due to limited resources (Brown et al., 2019). With that in mind, many semi-professional clubs also lack these resources and therefore the influence of physical pain could be underestimated in the present study. This is alarming, given the role that physical pain was found to have on mood in our analysis, especially for women. Our conclusions cannot be generalised to higher levels of participation; however, athletes continue to compete through pain at all levels of participation, including elite sport (Bush et al., 2020; Nixon, 1992; Roderick et al., 2000), highlighting that there may be a deeper attitude issue across various competitive levels that requires exploration.

Limitations

The present study has a relatively low sample size; however, it was not underpowered and therefore the risk of type II error was low. There is the risk of self-selection bias due to the

voluntary nature of our recruitment and student athletes who have experienced depressive symptoms may be over-represented in the sample, resulting in overestimation of prevalence. This too could be highlighted in the uneven distribution of male and female athletes. Women tend to report more depressive symptoms than men within sport (Wolanin et al., 2016) and outside of sport (Wege et al., 2018), and therefore self-selection bias could explain the uneven sample regarding biological sex. Female student athletes who have experienced depressive symptoms may be over-represented in the sample. As well as this, data collection commenced during the end-of-year exam period in the UK, symbolic of high stress levels in students which could explain the high prevalence of depressive symptoms in this sample.

Additionally, Belz et al. (2018) found that pain intensity and perceived disability should be regarded separately concerning risk for depression, but these were not measured in the present study. Therefore, we cannot conclude whether the findings regarding pain in this study are attributable to pain intensity or daily life restrictions. However, there could be an overlap between limitations in athletic performance and daily life restrictions with injury status, which has been found to have no impact on depressive symptoms here, contradicting Belz et al.'s (2018) findings. Therefore, Belz et al.'s (2018) recommendations ought to be followed in future research including pain intensity and perceived disability when investigating depressive symptoms.

The predominant sports that athletes took part in at time of participation may not be representative of all student athletes in the UK. Although just under a fifth of the sample played football, the most popular sport in UK universities (Marr et al., 2014), 40% selected the "other" category (excluding circuits, football, rugby, netball, or athletics). Therefore, we cannot make any sport-specific conclusions, but the study does capture depressive symptoms in student athletes across an array of sports, which provides insight into pain experiences more generally.

Knowledge application

Sports teams may be able to use the knowledge generated in this study to inform the support given to their athletes. For example, pain questionnaires could be utilised after training sessions or matches to identify those that are at risk of displaying depressive symptoms. Beyond the obvious duty of care to the athlete, this may also support better team performance (Opara, 2012). It should be emphasised that pain questionnaires cannot and should not be used as mental health diagnostic tools, but they may be an early indicator that individual athletes require additional support to prevent the negative effects of pain on their wellbeing.

Conclusions and future directions

The present study highlights how student athletes are at high risk of displaying depressive symptoms and offers useful insights into factors associated with depressed mood. The interaction between sex and pain promotes discussion regarding how male and female athletes cope with physical pain, with females more likely to display depressive symptoms at lower levels of physical pain. With the number of women athletes increasing (Leberman & Burton, 2017), it is important to be aware of any sex differences in depressed mood.

Using the information presented in this study, sports coaches may be better placed to support their players.

Data availability statement

Data is available on Open Science Framework: <https://osf.io/2t9ns/>

Disclosure statement

No potential conflict of interest was reported by the author(s).

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