A prospective study of teammate factors on athletes' well-being, disordered eating, and compulsive exercise

PLEASE CITE THE PUBLISHED VERSION

https://doi.org/10.1037/spy0000293

PUBLISHER

American Psychological Association (APA)

VERSION

AM (Accepted Manuscript)

A prospective study of teammate factors on athletes' wellbeing, disordered eating and compulsive exercise

Charlotte L Scott[1,2], Emma Haycraft[1] & Carolyn R Plateau[1*]

[1]School of Sport, Exercise and Health Sciences, Loughborough University, LE11 3TU, UK

[2]School of Psychology, University of Derby, Derby, DE22 1GB, UK

*The corresponding author is: Dr Carolyn Plateau, School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough, LE113TU. C.R.Plateau@lboro.ac.uk.

Accepted for publication in Sport, Exercise and Performance Psychology. Please cite as: Scott, C.L., Haycraft, E., & Plateau, C.R. (2022). A prospective study of teammate factors on athletes' wellbeing, disordered eating and compulsive exercise. *Sport, Exercise and Performance Psychology*. Doi: 10.1037/spy0000293

Acknowledgements

The authors would like to thank Dr Ian Taylor for his support with the statistical analyses.

Author note

Charlotte L Scott was funded by a PhD studentship awarded by the School of Sport, Exercise and Health Sciences at Loughborough University, UK. We have no conflicts of interest to disclose. The sample reported on in the present study is also the focus of two published articles - a social network analysis (Scott et al., 2021) and a mediation analysis (Scott et al., 2020) - but there is no overlap between the analyses of what is already published and what is presented here.

Scott, C. L., Haycraft, E., & Plateau, C. R. (2021). The influence of social networks within sports teams on athletes' eating and exercise psychopathology: A longitudinal study. *Psychology of Sport and Exercise*, *52*, 101786.

Scott, C. L., Plateau, C. R., & Haycraft, E. (2020). Teammate influences, psychological well-being, and athletes' eating and exercise psychopathology: A moderated mediation analysis. *International Journal of Eating Disorders*, *53*(4), 564-573.

A prospective study of teammate factors on athletes' wellbeing, disordered eating and compulsive exercise

Abstract

Cross-sectional research has demonstrated the strong influence teammates have on athletes' eating attitudes/behaviours, but less is known about the enduring nature of such influence or the stability of eating and exercise psychopathology over time. This study aimed to i) examine whether eating and exercise psychopathology and psychological wellbeing (anxiety, depression, self-esteem) in athletes remain stable over time, ii) examine which teammate factors predict athletes' eating and exercise attitudes/behaviours longitudinally, and iii) explore whether such predictive relationships differed as a function of gender/sport type/age group. Athletes (N=317, mean age 18.74 years, *n*=172 female, *n*=134 lean sport athletes) completed a survey at the beginning (T1) and middle (T2; 4 months later) of their athletic season exploring teammate factors, psychological wellbeing and eating/exercise psychopathology. Wilcoxon T-Tests assessed stability in variables over time (aim 1), Structural Equation Modelling tested the cross-lagged relationships among variables (aim 2), and tests of invariance explored group differences (aim 3). Levels of eating psychopathology significantly decreased from T1-T2 while levels of anxiety significantly increased. Notably, the cross-lagged model found higher levels of Self-Esteem at T1 predicted lower T2 Bulimia Modelling, and higher levels of Bulimia Modelling at T1 predicted higher T2 Disordered Eating. Males, those participating in non-lean sports and adolescent athletes are at increased risk of modelling teammate's disordered eating. Given the importance of understanding factors that can increase/reduce athletes' susceptibility to teammate influence, as well as the negative impact of teammate influence, these findings will inform the targeted development of team-based eating and exercise psychopathology prevention strategies.

Key words: Athlete; Social influence; Longitudinal, Disordered eating; Compulsive exercise

The predictive role of teammate influences on athletes' disordered eating and exercise attitudes and behaviours: A prospective study

The prevalence of dysfunctional attitudes/behaviours towards eating (e.g., unhealthy pre-occupation with food, feeling guilty after eating, feeling out of control around food) and exercise (e.g., craving exercise, negative affect when exercise missed) among athlete populations is high (e.g., Nattiv et al., 2007). Recent estimates of disordered eating are up to 47% for female athletes (e.g., Abbott et al., 2020) and 33% for male athletes (e.g., Karrer et al., 2020), while estimates of compulsive exercise are up to 53% in female athletes (Singh & Singh, 2021) and 37% in male athletes (Lichtenstein et al., 2014). Evidence suggests that indices of *poor* psychological wellbeing (i.e., low self-esteem, anxiety and depression symptomatology) are often integral to the development of problematic eating and exercise attitudes and behaviours, whereby behaviours such as excessive exercise, restriction or purging are carried out in an attempt to alleviate feelings of anxiety or depression (Fairburn et al., 2003; Meyer et al., 2011). Furthermore, the sport environment can also influence athletes' dysfunctional eating and exercise behaviours/attitudes (Freedman et al., 2021; Scott et al., 2019b). Indeed, the more pressure athletes perceive from their sport environment (e.g., from their teammates, coach, fans) regarding their appearance and weight, the more likely they are to engage in pathological weight control behaviours (Anderson et al., 2011).

Teammates in particular have been found to have a negative impact on athletes' disordered eating attitudes/behaviours, both directly and indirectly (Scott et al., 2019b). Unhealthy team norms (socially approved attitudes/behaviours) for eating and exercise may be *directly* precipitated by receiving critical comments or perceiving pressure from teammates to lose weight/change shape (Francisco et al., 2012; Muscat & Long, 2008). On the other hand, athletes may perceive their teammates to be engaging in disordered eating/weight control and in turn, model (imitate) such disordered behaviours (Engel et al., 2003). However, teammates may also have a preventative role against the development of disordered eating via the promotion of positive team norms around body image and the modelling of healthy eating practices (Smith & Ogle, 2006), which may be facilitated if teammate relationships are supportive (Shanmugam et al., 2014).

Most research investigating teammate influences on eating and exercise attitudes/behaviours has been limited by cross-sectional designs, which only provide a snapshot and may not capture changes in influences and behaviours across the sporting season. For example, perceived pressures from teammates may be particularly salient at the height of the competitive season, where training load, stress (Hyatt & Kavazis, 2019), and pressure to achieve the ideal physique is highest (de Bruin & Oudejans, 2018). Longitudinal research is therefore vital for determining whether influences from teammates temporally precede, and can thus be considered risk factors for, the development of eating and exercise psychopathology (Stice, 2002). To date, however, only a handful of studies have prospectively examined the role of social influences on disordered eating attitudes/behaviours in athletes, while only one has investigated the impact of team social networks on disordered *exercise* (Scott et al., 2021). This is an oversight, given that disordered eating and exercise behaviours are inextricably linked among athletes (Plateau et al., 2017) and together may seriously compromise athlete health and performance (Mountjoy et al., 2014).

Of the small number of studies which have employed a prospective design, Anderson et al. (2012) sampled aesthetic athletes and found that sport pressures at baseline did not predict dietary restraint six months later, leading them to conclude that this relationship may only appear simultaneously (as evidenced by their cross-sectional research; Anderson et al., 2011). Another study sampling aesthetic athletes failed to find a significant *direct* relationship between sport social pressures and disordered eating after a 12 month follow-up (Krentz & Warschburger, 2013). The lack of significant findings here may reflect the exclusive assessment of aesthetic (lean sport) athletes from sports where competitions are conducted individually (e.g., diving, gymnastics), rather than athletes from non-lean or team-based sport types (e.g., rugby) where athlete experiences of social pressures (particularly from teammates/training group members) may differ. Furthermore, these studies are limited in their assessment of a general “social pressure” from the sporting environment which amalgamated influences from the athletes’ teammates with influences from their coach, peers and spectators, meaning that the unique role played by teammates cannot be disentangled.

To date, only one longitudinal study has sampled athletes from a range of sports and provided data specifically on the role of teammates in the development of disordered eating (Shanmugam et al., 2014). Supportive teammate friendships at baseline predicted lower levels of disordered eating six months later. In contrast, conflicting teammate friendships at baseline predicted higher levels of disordered eating six months later. However, this study did not explore the role of sport type or gender making it difficult to determine whether these individual differences impact upon athletes’ susceptibility to teammate influence.

A general limitation of the aforementioned studies is the assessment of relationships between *one* social influence factor and a global measure of disordered eating/exercise behaviours (e.g., Krentz & Warschburger, 2013; Kroshus et al., 2015). This makes it difficult to establish whether particular factors of influence are more important than others - i.e., the impact of modelling of disordered eating behaviours versus conflicting teammate friendships on disordered eating *or* exercise. Disentangling these broad concepts is vital for the development of targeted intervention and prevention efforts to reduce disordered eating and exercise in athletes. In line with this, it is also important that individual athlete differences (e.g., gender, sport type, age) are accounted for when investigating risk factors for disordered eating and exercise and the conditions under which teammates can have the most impact. As highlighted in Petrie and Greenleaf’s (2007, 2012) theoretical etiological model of disordered in athletes, and more recently confirmed by Stoyel et al. (2020), it is vital that consideration is given to athletes' gender, sport type and age given the alternative presentation of disordered eating and combinations of risk factors across these groups.

Evidence suggests that female athletes may be more likely to experience low self-esteem, anxiety and depression symptomatology (Walton et al., 2021) and are more susceptible to disordered weight control behaviours due to internal conflicts and body dissatisfaction that arise when comparing their sport's "athletic ideal" to society's "thin-ideal" (Smith & Petrie, 2008). Similarly, lean sport athletes may be more susceptible due to the perceived requirement of a smaller physique for performance success (e.g., gymnastics, diving) and those with negative affect (e.g., low self-esteem, anxiety and depression) often have a greater susceptibility to negative influences from teammates regarding disordered weight control (Scott et al., 2019a; Scott et al., 2020; Shanmugam et al., 2013). In addition, adolescent athletes may be more susceptible to disordered eating/compulsive exercise not only in response to the prevalent culture of dieting, muscle building behaviours, and body image pressures during adolescence (in line with the general population; Rodgers et al., 2020), but also because younger athletes are heavily influenced and affected by the actions of their peers especially when considering that peers often replace parents as the primary source of social influence during adolescence (Chan et al., 2012). On the other hand, university student-athletes (18+) may experience more intense changes to their mental wellbeing (i.e., anxiety/depression) in response to academic stress relative to their younger counterparts (Sheehan et al., 2018), highlighting the need to evaluate the potential impact of age.

Findings from prospective studies have demonstrated that athletes' levels of eating psychopathology typically remain stable over time (Krentz & Warschburger, 2013; Shanmugam et al., 2014; Voelker et al., 2016). However, research has yet to conclusively determine the stability of athletes' *exercise* psychopathology. For example, an *increase* in training-induced distress (a marker of overtraining) was identified in adolescent athletes over a 3-month period (Madigan et al., 2017), indicating that small fluctuations may occur at discrete points within the year, while Thompson et al. (2017) identified athletes' engagement in weight control exercise remained stable over a 5 month athletic season. On the other hand, research in relation to psychological wellbeing demonstrates a higher degree of variability over time. For example, Sheehan et al. (2018) found a significant improvement in athletes' levels of anxiety and depression over the course of a 3-month season, while Voelker et al. (2016) found negative affect (anger, guilt, sadness) had the lowest degree of stability relative to measures of disordered eating and body dissatisfaction over a 5-month season. Furthermore, mood state disturbances have been found to increase in tandem with training load increases and have been linked with overtraining (Morgan et al., 1987). It is vital to understand the temporal nature of psychological wellbeing given its role in the development and maintenance of both eating psychopathology (Fairburn et al., 2003) and exercise psychopathology (Meyer et al., 2011). If athletes experience negative changes to their psychological wellbeing, it is plausible that their eating and exercise behaviours are also negatively impacted (e.g., Scott et al., 2020). Alternatively, it could be argued that that engagement in problematic eating and exercise behaviours negatively impacts psychological wellbeing (e.g., Espinoza et al., 2019; Rodgers et al., 2020).

Aims of the current study

To address the gaps and limitations of existing literature, the first aim of the present study was to examine whether eating and exercise psychopathology and psychological wellbeing (anxiety, depression, self-esteem) in athletes remain stable over a four-month period. In accordance with prior literature, we hypothesised that eating and exercise psychopathology would demonstrate higher levels of stability compared to psychological wellbeing. A second aim was to prospectively examine which teammate factors are the best longitudinal predictors of athletes' eating and exercise attitudes/behaviours. We hypothesised that positive teammate factors (e.g., supportive friendships) at the beginning of the season (T1) would significantly predict lower eating and exercise psychopathology levels in the middle of the season (T2), whereas negative teammate factors at T1 (e.g., modelling of disordered weight control behaviours) would significantly predict higher eating and exercise psychopathology levels at T2. A final aim was to explore whether the predictive relationships between teammate factors and eating and exercise psychopathology differed as a function of gender, sport type (lean vs non-lean) and age group (adolescents vs non-adolescents).

Method

Participants and Procedure

Ethical approval for this study was granted by the Institutional Ethics Approvals (Human Participants) Sub-Committee. Gatekeepers (e.g., coach; club chairperson) for adult and adolescent teams of athletes in the UK were contacted via email and sent information outlining the study. Parental consent was obtained for athletes under 18. At each time point (T1=October 2017, T2=February 2018), adolescent athletes provided their assent and completed questionnaires in person either before or after a training session. Athletes aged 18 years and over provided informed consent and completed the questionnaires in person at T1 and via an online survey at T2. All athletes that took part were either university students (aged 18 years and above), or school students (aged 15-18 years) where their sporting commitments typically occurred within the academic year (i.e., September–July).

At T1, 388 athletes completed the survey and 351 participated at T2 (90% retention rate), on average 3.75 months later (SD=0.28, Range=3.45-4.14 months). Of the T2 participants, 34 athletes reported no longer competing with their team, or did not complete teammate factor measures (*n*=6) so were excluded, leaving a final sample of 311. To achieve the medium sized (i.e., β=0.20-0.30) standardised beta values that are typically identified in this research area (e.g., Scott et al., 2019a) with power at 0.8 and $p<0.01$, a sample of 147 was identified as necessary given the 8 predictors in the model (Cohen, 1992). This sample size was also deemed to satisfy to satisfy our post-hoc RMSEA power-based calculation which required a minimum sample of 132 participants to achieve power at 0.80 to reject RMSEA at 0.05 (Jak et al., 2020).

Comparison of the completers (*n*=311) and non-completers (*n*=77) revealed no significant differences on any demographic or T1 eating and exercise variables. Of the final sample (n = 311), 54% were female (*n*=171), and 81% were of White ethnicity (*n*=253). The mean age was 18.74 years (SD=2.66) and mean BMI was 21.83 kg/m^2 (SD=2.47). Sixty percent of the sample were aged 18 and over and competed with a university sports team while the remaining 40% were under 18 and competed with their club or school. A small proportion (18%) of the sample reported having competed at the elite level with their team (national/international level), for example, a university cheerleading team or U18 rowing club competing at national events. Athletes from 29 different teams or training groups took part, each supported by a different coach. Forty-two percent (*n*=134) participated in lean sports (e.g., aesthetic, endurance, weight-class) and 58% (*n*=185) competed in non-lean sports (e.g., ballgame, power, technical) as defined by Sundgot-Borgen and Larsen (1993). The gender split was roughly equal within the adolescent/adult and lean/non-lean sport groups. The athletes had been a member of their current team for an average of 1.98 years (SD=2.67) and trained for their sport on average 5.47 hours/week (SD=3.22). Outside of training/competing, athletes spent an average of 8.15 (SD=10.76) additional hours in the company of their teammates and reported that their friendships with teammates made up an average of 39.4% (SD=24.15) of their total friendships. Forty athletes competed in individual-based sports (e.g., gymnastics, running, dance), while regularly training as part of a cohesive group.

Measures

At baseline only, participants provided the following demographic information: self-reported height and weight, gender, age, ethnicity and English-speaking status. The following standardised measures were completed at both time points of the study. In addition to these, participants completed the Perceived Sociocultural Pressures Scale (Stice & Bearman, 2001), Social Support for Healthy Eating Scale – Athlete (Scott et al., 2019a) and Depression subscale of the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) but these measures failed to achieve acceptable model fit.

Friends Anti-Dieting Scale (FADS; Shroff, 2004)

The frequency with which athletes received anti-dieting and anti-weight control advice from their teammates was assessed using the FADS, which is validated for use with athletes and has demonstrated acceptable internal reliability in this population (Kroshus et al., 2015). Participants responded to five items on a 5-point Likert (1="never"; 5="very often"), where higher total scores indicate greater levels of anti-dieting and anti-weight control advice from teammates. Item wording was modified in the present study to assess 'weight-control behaviours' in addition to dieting - e.g., "How often do your teammates talk about reasons why dieting or *engaging in weight control behaviours* can be dangerous?".

Bulimic Modelling Scale (BMS; Stice, 1998)

Teammate modelling of bulimic-type behaviours was assessed using the BMS. The scale comprises five items which were tailored to the athletes' teammates and assessed binge eating, vomiting to control weight, dietary restraint, pre-occupation with weight/shape, extreme weight control behaviours (e.g., "One or more of my teammates has dieted to lose weight and/or change their shape"). This scale has been validated for use in young adult populations and has good internal and test-retest reliability (Stice, 1998). Participants answered using a 5-point Likert scale (1="never"; 5="very often") with higher mean scores indicative of greater modelling behaviours. To improve model fit in the analysis, one low loading item was removed.

Sport Specific Quality of Relationship Inventory (SSQRI; Jowett, 2009)

The SSQRI assesses athletes' perceptions of relationship quality with their teammates and has been validated for use in athlete populations, with acceptable internal reliability (Jowett, 2009). A 4-point Likert scale (1="not at all"; 4="very much") was used to assess interpersonal conflict (SSQRI-C; 6 items, e.g., 'How often do you need to work hard to avoid conflict with your teammates') and social support (SSQRI-S; 6 items, e.g., 'To what extent could you turn to your teammates for advice about problems?), with higher mean scores for each subscale reflecting greater levels of support and conflict in the teammate relationship.

Brief-Rosenberg's Self Esteem Scale (B-RSES; Monteiro et al., 2021)

The original RSES assesses global self-esteem using 10 items (e.g., 'On the whole, I am satisfied with myself') with a 4-point Likert scale (1="strongly disagree"; 4="strongly agree"), where higher total scores indicate greater self-esteem (Rosenberg, 1965). To improve model fit for the analysis, only the 5 items comprising the B-RSES were taken forward into the analysis. This shorter version of the scale is validated for use in young adults and has demonstrated good internal reliability in this population (Monteiro et al., 2021).

Hospital Anxiety and Depression Scale-Anxiety (HADS-A; Zigmond & Snaith, 1983)

The HADS-A assesses anxiety symptomatology (7 items, e.g., 'Worrying thoughts go through my mind') using a 4-point Likert scale from 0 to 3. Higher total scores reflect greater levels of anxiety. The HADS-A has been validated for use with athletes and high internal reliability has been identified for the anxiety subscale (Weber et al., 2018).

Eating Disorder Inventory-Very Short (EDI-VS; Maiano et al., 2016)

Three subscales comprising the EDI-2 short form assess disordered eating attitudes and behaviours: Drive for Thinness (EDI-DT; 7 items, e.g., 'I think about dieting'); Bulimia

(EDI-BUL; 7 items, e.g., 'I stuff myself with food'); and Body Dissatisfaction (EDI-BD; 9 items, e.g., 'I think my stomach is too big') (Garner, 1991). A 6-point Likert scale was used ("never" to "always"), where higher total scores for each subscale reflect greater levels of eating psychopathology. To improve model fit, the six items comprising the EDI-DT, EDI-BUL and EDI-BD subscales of the Eating Disorder Inventory – Very Short form *(*EDI-VS; Maiano et al., 2016) were taken forward into the analysis and added together to create a composite "Disordered Eating" scale. The EDI-VS has been validated for use, with good internal reliability identified for each of the subscales (Maiano et al., 2016).

Compulsive Exercise Test - Athlete version (CET-A; Plateau, et al., 2014)

The CET-A assesses athletes' attitudes/feelings towards exercise and weight control reasons for exercise (as a proxy for their compulsive exercise behaviours). The scale comprises three subscales; exercise to avoid negative affect (6 items, e.g., 'If I cannot exercise I feel angry or frustrated'), improve mood (5 items, e.g., 'I feel happier and/or more positive after I exercise'), and control weight (4 items, 'I exercise to burn calories and to lose weight'). A 6-point Likert scale was used (0="never true"; 5="always true") where higher mean scores for each subscale reflect greater exercise psychopathology. A global score was created by adding together the means of the three subscales. To improve model fit for the analysis, 3 items were removed from the scale (one from each subscale). The CET-A has been validated for use with athlete populations and has demonstrated acceptable internal reliability for the global scale (Plateau, et al., 2014).

Data analyses

Preliminary analyses

Analyses were performed using IBM SPSS (version 27.0) and IBM AMOS (version 27.0) using an alpha value of $p<0.001$ given the large number of tests conducted. To confirm validity of the standardised measures employed with the present sample, Exploratory

Structural Equation Modelling at baseline (T1) and follow up (T2) was conducted for each measure separately. At both time points, all measures yielded at least an acceptable model fit with the data (Table S1) and had at least acceptable internal reliability (McDonald's omegas) (Table 1). Inspection of histograms revealed very few of the study variables to be normally distributed, so non-parametric statistics were employed where possible. Descriptive statistics for the sample as a whole for both time points were computed (Table 1), as well as two-tailed Spearman's *rho* correlations between all study variables at baseline (Table S2). Given the well-established link between BMI and eating/exercise psychopathology (e.g., Shanmugam et al., 2012), correlations between BMI and eating/exercise psychopathology were examined to assess whether BMI needed to be controlled for in subsequent analyses. However, no significant relationships were found. Furthermore, no cases of multicollinearity (r>0.90; Pallant, 2010) amongst teammate factor variables were found (Table S2).

Given that data were collected with individual athletes on a team-by-team basis, it was important to ensure that the independence of observations assumption was not violated for the eating and exercise outcome variables. Unconditional linear models were therefore conducted for each outcome variable in turn. Findings yielded acceptable ICC correlations (≤0.10) and design effects of ≤1.90. The data were deemed to be sufficiently independent for individual level analyses (Snijders & Bosker, 2011).

Primary analyses

To examine the stability of study variables over time (aim 1), a series of Wilcoxon T-tests of difference were conducted between variables at T1 and T2 (Table 1). To investigate whether teammate factors predicted longitudinal changes in psychological wellbeing, eating and exercise psychopathology, and vice versa (aim 2), structural equation modelling (SEM) was employed using manifest variables to test and compare models. To ensure an accurate evaluation of model fit, it is recommended that a range of fit indices are examined (e.g., Hu

& Bentler, 1999). In the present study, comparative fit index (CFI), Standardised Root Mean Square Residual (SRMR), Root Mean Square Error of Approxiation (RMSEA), and Chi Square were evaluated. The following cut-off values were used as benchmarks for an acceptable model fit: CFI >.90; SRMR <.10 (Marsh et al., 2004), RMSEA ≤0.80 (Browne & Cudeck, 1993) and good model fit: CFI >0.95; SRMR ≤0.08 (Marsh et al., 2004); RMSEA ≤ 0.05 (Browne & Cudeck, 1993). However, an SRMR of 0.14 has been noted as permissible if sample sizes are >250 and measures in the model have high internal reliability (Hu & Bentler, 1999; McNeish & Wolf, 2021). Error terms among the manifest variables were set to covary at each time point if they significantly correlated.

Model 1 included stability coefficients only and served as the baseline model (i.e., including T1 – T2 pathways within each manifest variable (e.g., T1 EDI-VS – T2 EDI-VS)). Model 2 (cross-lagged model) additionally included cross-lagged paths from T1 teammate factors, psychological wellbeing, eating and exercise psychopathology to T2 teammate factors, psychological wellbeing, eating and exercise psychopathology. For model 1, Mardia's coefficient was 58.83 with a critical ratio of 21.61 indicating significant deviations of the data from multivariate normality (Bentler & Eric, 2005). As a result, all structural models were tested in AMOS using the Maximum Likelihood estimation and employed bootstrapped 95% bias-corrected confidence intervals which are robust to non-normality.

To test aim three and evaluate whether longitudinal relationships differed as a function of gender, sport type (lean vs non-lean sport) or age group (adolescent vs adult), two methods were employed as per Stoyel et al. (2020). First, AMOS multigroup analysis was employed to examine if the constrained models differed from the unconstrained model by an amount equal to or larger than .01 for the CFI model fit indicator. This confirms that the model differs between groups (Milfont & Fischer, 2010). Secondly, a Chi-square difference test using an Excel Macro was then employed to further confirm whether or not the models being compared were invariant. Standardised Regression Weights were then inspected for each group separately to establish where the differences were occurring.

Results

Descriptive statistics

Descriptive statistics for study variables at T1 and T2 are presented in Table 1. Scores on the teammate factors and wellbeing measures were broadly comparable to previous research with athletes (FADS, Kroshus et al., 2015; BMS, CET-A, HADS-A; Scott et al., 2019a; SSQRI, Shanmugam et al., 2013, 2014) and general young adult/adolescent populations (B-RSES; Monteiro et al., 2021; EDI-VS; Maiano et al., 2016).

Aim 1: examining stability of variables over time

A series of Wilcoxon T-Tests examined whether study variables remained stable or changed significantly over time (Table 1). Levels of Disordered Eating decreased significantly between T1 (Mean=2.42; SD=2.78) and T2 (Mean=2.09; SD=2.62) (Z=-2.93, p<0.001) with a small effect size (r=0.16) while levels of Anxiety increased significantly between T1 (Mean=7.03; SD=3.43) and T2 (Mean=7.82; SD=3.28) (Z=-6.53, p<0.001) with a medium effect size (r=0.37). No other significant changes were identified.

Aim 2: examining longitudinal relationships among variables

The Baseline-Stability model represented a good fit with the data ($\chi 2$ (51)=98.02, df=154), p<0.001, CFI=0.98, RMSEA=0.06 [90%CI=0.04, 0.07], SRMR=0.11, and AIC=268.12, $\chi 2$=98.02, df=51, p<0.001. Across the 8 manifest variables from T1 to T2, significant portions of variance were explained (all ps<0.001). Generally, variance explained was lower for teammate factor variables (Anti-dieting advice=11%, Supportive Friendships=36%, Conflicting Friendships=22%, Bulimia Modelling=27%) compared to psychological wellbeing and eating/exercise psychopathology variables (Self-Esteem=35%, Anxiety = 69%, Disordered Eating=48%, Compulsive Exercise=44%).

The Cross-Lagged structural model represented a very good fit with the data, χ^2 (48)=68.66, p=0.03, CFI=0.99, RMSEA=0.04, [90% CI=0.01-0.06], SRMR=0.08 and AIC=244.66. Based on the decreases observed in the $\Delta\ \chi^2$ (98.02-68.66)=29.36, RMSEA and SRMR indices as well as the increase in CFI, it was concluded that the cross-lagged model provided a better fit for explaining the relationships between the T1 and T2 manifest variables in comparison to the baseline stability model.

In this cross-lagged model, the T1 to T2 baseline-stability pathways for each manifest variable were again strong and significant (p<0.001). All potential cross-lagged pathways were tested and three of these were significant (see Figure 1): (a) Higher T1 Conflicting Friendships predicted decreases in T2 Supportive Friendships, beyond the variance already accounted for by T1 Supportive Friendships (β=–0.15 [95%CI=-0.23, -0.07], p<0.001); (b) Higher T1 Bulimia Modelling predicted increases in T2 Disordered Eating beyond the variance explained by T1 Disordered Eating (β=0.13 [95%CI=0.05, 0.21], p<0.001); and (c) Higher T1 Self-Esteem predicted decreases in T2 Bulimia Modelling beyond the variance explained by T1 Bulimia Modelling (β=-0.15 [95%CI=-0.22, -0.07], p<0.001).

Aim 3: exploring group differences in longitudinal relationships among variables

For all groups (i.e., males, females, lean sport athletes, non-lean sport athletes, adolescents, adults), the structural model identified in Aim 2 demonstrated at least an acceptable fit with the data. Multigroup invariance testing confirmed that group differences in model fit existed between genders, sport types and age groups. All fully constrained models differed from the unconstrained model by >.01 for the CFI. See Tables S3 (gender), S4 (sport type) and S5 (age group).

Gender differences

The model fit better for female athletes (χ^2 (48)=73.28, p=0.01; CFI=0.98; RMSEA=0.06 [90% CI=0.03, 0.08]; SRMR=0.13; AIC=249.28) than it did for male athletes

(χ^2 (48)=72.88, p=0.01; CFI=0.97; RMSEA=0.06 (90% CI=0.03, 0.09); SRMR=0.19; AIC=248.88). For males only, higher T1 Bulimia Modelling predicted higher T2 Disordered Eating (β=0.27 [95%CI=0.07, 0.57], p<0.001).

Sport type differences

The model fit better for lean sport athletes (χ^2 (48)=66.75, p=0.04; CFI=0.98; RMSEA 0.05 [90% CI=0.01, 0.08]; SRMR=0.16; AIC=242.75) than it did for non-lean sport athletes (χ^2 (48)=82.28, p=0.002; CFI=0.97; RMSEA=0.06 [90%CI=0.04, 0.09]; SRMR=0.15; AIC=258.28). For non-lean sport athletes only, higher T1 Conflicting Friendships predicted lower T2 supportive friendships (β=-0.17 [95%CI=-0.28, -0.05], p<0.001) higher T1 Self-Esteem predicted lower T2 Bulimia Modelling (β =-0.17 [95%CI=-0.28, -0.06], p<0.001) and higher T1 Bulimia Modelling predicted lower T2 Disordered Eating (β=0.19 [95%=0.07, 0.33], p<0.001).

Age group differences

The model fit better for adult athletes (χ^2(48)=56.42, p=0.19; CFI=0.99; RMSEA=0.03 [90% CI=0.00, 0.06]; SRMR=0.17; AIC=232.42) than it did for adolescent athletes (χ^2(48)=64.88, p=0.05; CFI=0.98; RMSEA=0.05 (90%CI=0.00, 0.08); SRMR=0.18; AIC=240.88). For adolescents only, higher T1 Bulimia Modelling predicted higher T2 Disordered Eating (β=0.23 [95%CI=0.11, 0.38], p<0.001) and higher T1 Conflicting Friendships predicted lower T2 supportive friendships (β=-0.20 [95%CI=-0.33, -0.09], p<0.001).

Discussion

The key aims of this longitudinal study were to investigate the stability of eating/exercise psychopathology and psychological wellbeing among athletes over time, to examine which teammate factors were the best predictors of eating/exercise psychopathology, and to explore the presence of gender, sport type and age group differences. To the authors' knowledge, this study is the first to assess the stability of athletes' *exercise* psychopathology. Additionally, in comparison to existing prospective studies, the timing of the follow-up (i.e., four months) enabled the evaluation of change *within* the athletic season when pressures to perform and thus maintain peak fitness are highest (Hyatt & Kavazis, 2019).

In the present study, athletes' levels of eating psychopathology significantly decreased (but remained within the normal range) during their athletic season, with T1 Disordered Eating accounting for 48% of the variance in T2 Disordered eating. It is worth noting that this percentage of variance explained is lower than previous studies which have employed *pre-post season* designs to assess change in eating psychopathology. For example, Voelker et al. (2016) found 67% and 65% of the variance in dietary restraint and bulimic symptoms at their 5-month follow up were respectively accounted for by baseline levels. This highlights that athletes may be more likely to experience short-term fluctuations in their eating psychopathology at discreet points within their season. Furthermore, the current study is the first to demonstrate the stability of exercise psychopathology over time, with no significant change identified from T1-T2. The relatively low levels of T2 variance accounted for in both Compulsive Exercise (44%) and Disordered Eating (48%) are important to note here. These findings are meaningful because (within season, at least) baseline levels are only one of perhaps many other factors (e.g., teammates) contributing to changes in these disordered behaviours which researchers need to be targeting.

While athletes' levels of disordered eating decreased, their levels of anxiety significantly increased from pre-season to mid-season. Such increases could be attributed to the dual career nature of the student-athletes sampled. Balancing the progression of the athletic season (i.e., high competition/training load) with academic stress can make this a very challenging time (Sheehan et al., 2018). Sport practitioners should be informed about the additional psychological support student-athletes may require during their midseason. In addition, given the extensive literature suggesting a link between elevated anxiety/depression and subsequent elicitation and maintenance of eating/exercise psychopathology (e.g., Fairburn et al., 2003; Meyer et al., 2011), it is vital that the role of negative affect is unpacked in future investigations. Importantly, T1 Anxiety accounted for 69% of the variance in T2 Anxiety, meaning that (unlike eating/exercise psychopathology and self-esteem) baseline level of anxiety is the best predictor of athletes' future experience of anxiety.

Interestingly, while anxiety and self-esteem were not longitudinal predictors of eating/exercise psychopathology in the present study, high self-esteem *was* found to be a significant predictor of decreased instances of bulimia modelling, primarily for non-lean sport athletes. It is plausible that those with high self-esteem are somewhat protected against perceiving a social pressure to attain the ideal body, which in turn reduces their likelihood of internalisation/social comparison (Rodgers et al., 2020). Previous longitudinal research with athletes has found the opposite; i.e., that modelling of bingeing/purging attitudes and behaviours is a prospective predictor of decreased self-esteem (Scott et al., 2020). This highlights the potential bidirectionality of this relationship and suggests further avenues for disordered eating prevention in athlete groups. For example, strategies to boost athletes' self-esteem and self-compassion (e.g., Bodies in Motion intervention; Voelker et al., 2019) may reduce the likelihood that they model their teammates disordered weight control behaviours.

The second aim of this study was to assess the predictive role of teammate factors on athletes' eating and exercise psychopathology over time. After controlling for baseline eating and exercise, the only significant predictor was bulimia modelling. Specifically, modelling of teammates' disordered weight control behaviours predicted a subsequent increase in disordered eating attitudes and behaviours. While these findings contrast with existing prospective research which failed to find a predictive role for *general* sport social pressures (e.g., coach, judges, fans) on eating psychopathology (Anderson et al., 2012; Krentz & Warschburger, 2013), they extend existing cross-sectional research which has demonstrated an association between teammate modelling and eating psychopathology (Engel et al., 2003; Kroshus et al., 2015; Shanmugam et al., 2013). Given that relationships with teammates provide athletes with a unique sense of belonging and validation of self-worth beyond that acquired with non-athletic peer relationships (Riley & Smith, 2011), it follows that athletes are highly attuned to the behaviours of their teammates, enabling them to play the facilitatory role in the development of eating psychopathology highlighted in the present study.

Interestingly, in contrast to much of the existing cross-sectional research (Kroshus et al., 2015; Scott et al., 2019a; Shanmugam et al., 2013), longitudinal associations were not apparent between eating or exercise psychopathology and athletes' relationship quality with their teammates or anti-dieting advice received from teammates. It is plausible that these relationships only exist cross-sectionally, especially in light of the comparatively low level of variance explained in teammate factors identified (T1 teammate factors only explained 11-36% of variance in T2 teammate factors). While peer relationship quality in particular has been found to be stable over several years in school children (Choi & Kim, 2021), specific peer influence factors may be highly volatile during shorter time periods such as an athletic season. However, experiencing higher levels of conflict in teammate friendships was found to longitudinally predict lower levels of support in teammate friendships. This lends support to the notion that these aspects of relationships are strongly interlinked and it follows that having teammate friendships characterised by conflict and distrust is likely to be inversely related to supportive friendships over time. Coaches should be made aware of the potential negative impact that conflicting teammate friendships can have and they should aim to foster teammate friendships characterised by trust and warmth, given evidence to suggest this plays a protective role against the development of eating psychopathology (Scott et al., 2020).

A final aim was to explore any gender, sport type (lean sport vs non-lean sport) or age group (15-17 years vs 18-25 years) differences in the relationship between teammate factors and eating/exercise psychopathology. The model fit was found to vary as a function of gender, sport type and age group. Notably, the relationship between higher T1 Bulimia modelling and higher T2 Disordered Eating was particularly pronounced among males, adolescents and those competing in non-lean sports. It is unsurprising that adolescent athletes appear to be at higher risk of teammate modelling given the intense body image pressures and prevalent culture of dieting/muscle building behaviours in this age group (Rodgers et al., 2020), alongside a greater susceptibility to influence from teammates relative to others in their social environment (Chan et al., 2012).

What is interesting, however, is that this relationship was identified primarily for non-lean sport athletes. Arguably, particularly for *females* taking part in non-lean sports, the discrepancy between their sports' "athletic ideal" (e.g., muscular for rugby) and society's "thin-ideal" is potentially larger compared to those competing in lean sports (e.g., thin/toned for gymnastics) where these pressures are more aligned (Smith & Petrie, 2008). As such, non-lean sport athletes, may be more inclined to imitate the behaviours of their teammates in order to reduce the discrepancy. In line with this, the finding that teammate modelling was salient for male athletes confirms recent qualitative findings highlighting that male athletes reportedly "measure up" their opponents/role models which extends to the imitation of their training and dietary behaviours, often exacerbated by social media (Stoyel et al., 2021, p.5).

These findings hold important practical implications. Athletic clubs, universities, and sport organisations need to be aware of, and recognise, the negative impact teammates may have in relation to athletes' eating psychopathology. Sport healthcare professionals should consider implementing disordered eating prevention strategies with at-risk populations (e.g., males, adolescents and non-lean sport athletes). To date, preventative cognitive dissonance paradigms have been used successfully to improve body image, challenge unrealistic societal ideals around body weight/shape and subsequently reduce the use of disordered weight control strategies (e.g., Voelker et al., 2019). To increase efficacy, programmes may benefit from fostering increased self-esteem which may buffer against the likelihood of athletes' subsequent modelling of disordered behaviours demonstrated in this study.

The present study builds on the limitations of previous cross-sectional research by being the first to *prospectively* assess the impact of multiple teammate factors on eating and exercise psychopathology over time. Conclusions drawn are strengthened by the assessment of a large (N=317), representative (i.e., balanced gender, sport type, age group) sample of athletes, and the inclusion of baseline-stability relationships in the analysis. The retention rate (90%) is also far higher in comparison to other similar prospective studies (e.g., 21%, Krentz & Warshburger, 2013; 67%, Shanmugam et al., 2014), increasing confidence in the findings.

Limitations

First, while the present study has found athletes' exercise psychopathology to remain relatively stable within an athletic season, it is unclear whether stability continues as athletes transition into the *off*-season, characterised by a reduction in training and weight change (Sundgot-Borgen & Garthe, 2011). For a more comprehensive understanding of eating/exercise psychopathology and the teammate factors that may increase risk, future research should ensure such variables are examined at discrete points throughout the athletic season. Second, it has recently been found that those who strongly relate to the athlete role (high athletic identity) but compete at the sub-elite level (an identity mis-match) are at an increased risk of disordered eating behaviours (Palermo & Rancourt, 2019). Future research should therefore account for such confounders of eating/exercise psychology in athletes (e.g., athletic identity, Madigan et al., 2017; perfectionism, Turton et al. 2017). Third, for two scales (BMS and CET-A), some items were removed in order to achieve the strong model fit required for structural equation modelling. While the number of items removed did not exceed the recommended 20% of the total scale items (Awang, 2016), these modified scales may lack validity. Finally, the coach's education level and their perceived competency in identifying and preventing disordered eating and compulsive exercise among their athletes is likely to play a large role in athletes' subsequent development of these behaviours (Plateau et al., 2014). Future research in this field would benefit from further exploration of coach factors.

Conclusion

In summary, this prospective study with athletes demonstrated that, levels of compulsive exercise and self-esteem remained stable over time whereas levels of anxiety and disordered eating changed significantly. Notably, higher levels of self-esteem reduced the likelihood athletes would model their teammates' disordered weight control behaviour. In addition, elevated eating psychopathology was predicted by greater instances of modelling of teammates' disordered weight control behaviour, with this finding more pronounced for males, adolescents and non-lean sport athletes. Given the need to better understand factors that increase or reduce susceptibility to teammate influence as well as the enduring nature of teammate influence, these findings help to inform targeted development of eating and exercise psychopathology prevention strategies.

References

Abbott, W., Brett, A., Brownlee, E. T., Hammond, M. K., Harper, D. L., Naughton, J. R., Anderson, L., Munson, H. E., Sharkey, V. J., Randell, K. R., & Clifford, T. (2020). The prevalence of disordered eating in elite male and female soccer players. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, *27*, 1–8.

Anderson, C., Petrie, T., & Neumann, C. (2011). Psychosocial correlates of bulimic symptoms among NCAA division-I female collegiate gymnasts and swimmer/divers. *Journal of Sport & Exercise Psychology*, *33*(4), 483–505.

Anderson, C., Petrie, T., & Neumann, C. (2012). Effects of sport pressures on female collegiate athletes: A preliminary longitudinal investigation. *Sport, Exercise, and Performance Psychology*, *1*(2), 120–134.

Awang, Z. (2016). Validating the measurement model: CFA. In *A Handbook on SEM 2nd Edition* (pp. 53–74).

Bentler, P. M., & Eric, W. (2005). *EQS 6.1 for Windows.* Multivariate Software INC.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Sage.

Chan, D. K., Lonsdale, C., & Fung, H. H. (2012). Influences of coaches, parents, and peers on the motivational patterns of child and adolescent athletes. *Scandinavian Journal of Medicine & Science in Sports*, *22*(4), 558–568.

Choi, J. H., & Kim, K. E. (2021). A cross-lagged model of the social withdrawal and peer relationships in obese children. *Annals of the Romanian Society for Cell Biology*, 753–763.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159.

de Bruin, K., & Oudejans, R. (2018). Athletes' body talk: The role of contextual body image in eating disorders as seen through the eyes of elite women athletes. *Journal of Clinical*

Sport Psychology, *12*(4), 675–698.

Engel, S. G., Johnson, C., Powers, P. S., Crosby, R. D., Wonderlich, S. A., Wittrock, D. A., & Mitchell, J. E. (2003). Predictors of disordered eating in a sample of elite Division I college athletes. *Eating Behaviors*, *4*(4), 333–343.

Espinoza, P., Penelo, E., Mora, M., Francisco, R., Gonzalez, M. L., & Raich, R. M. (2019). Bidirectional relations between disordered eating, internalization of beauty ideals, and self-esteem: A longitudinal study with adolescents. *The Journal of Early Adolescence*, *39*(9), 1244–1260.

Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: A "transdiagnostic" theory and treatment. *Behaviour Research and Therapy*, *41*(5), 509–528.

Francisco, R., Alarcão, M., & Narciso, I. (2012). Aesthetic sports as high-risk contexts for eating disorders—Young elite dancers and gymnasts perspectives. *The Spanish Journal of Psychology*, *15*(1), 265–274.

Freedman, J., Hage, S., & Quatromoni, P. A. (2021). Eating Disorders in Male Athletes: Factors Associated With Onset and Maintenance. *Journal of Clinical Sport Psychology*, *1*, 1–22. https://doi.org/10.1123/jcsp.2020-0039

Garner, D. M. (1991). Eating disorder inventory-2. In *Professional Manual*.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional versus new alternatives. *Structural Equation Modeling: A Multidisciplincary Journal*, *6*(1), 1–55.

Hyatt, H., & Kavazis, A. (2019). Body Composition and Percieved Stress through a Calendar Year in NCAA I Female Volleyball Players. *International Journal of Exercise Science*, *12*(5), 433–443.

Jak, S., Jorgensen, T. D., Verdam, M. G., Oort, F. J., & Elffers, L. (2020). Analytical power calculations for structural equation modeling: A tutorial and Shiny app. *Behavior Research Methods*, *2*, 1–22.

Jowett, S. (2009). Validating coach-athlete relationship measures with the nomological network. *Measurement in Physical Education and Exercise Science*, *13*(1), 34–51.

Karrer, Y., Halioua, R., Motteli, S., Iff, S., Seifritz, E., Jager, M., & Claussen, M. C. (2020). Disordered eating and eating disorders in male elite athletes: a scoping review. *BMJ Open Sport & Exercise Medicine*, *6*(1), e000801.

Krentz, E., & Warschburger, P. (2013). A longitudinal investigation of sports-related risk factors for disordered eating in aesthetic sports. *Scandinavian Journal of Medicine & Science in Sports*, *23*(3), 303–310.

Kroshus, E., Kubzansky, L., Goldman, R., & Austin, S. B. (2015). Anti-dieting advice from teammates: a pilot study of the experience of female collegiate cross country runners. *Eating Disorders*, *23*(1), 31–44.

Lichtenstein, M. B., Christiansen, E., Elklit, A., Bilenberg, N., & Stoving, R. K. (2014). Exercise addiction: a study of eating disorder symptoms, quality of life, personality traits and attachment styles. *Psychiatry Research*, *215*(2), 410–416.

Madigan, D., Stoeber, J., & Passfield, L. (2017). Athletes' perfectionism and reasons for training: Perfectionistic concerns predict training for weight control. *Personality and Individual Differences*, *115*, 133–136.

Maiano, C., Morin, A. J., Monthuy-Blanc, J., Garbarino, J. M., & Ninot, G. (2016). Development and validity of a very short form of the Eating Disorder Inventory. *Comprehensive Psychiatry*, *65*(2), 141–149.

Marsh, H. W., Hau, K. T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentlet's (1999) findings. *Structural Equation Modeling*, *11*(3), 320–341.

McNeish, D., & Wolf, M. G. (2021). Dynamic fit index cutoffs for confirmatory factor analysis models. *Psychological Methods*. https://doi.org/https://doi.org/10.1037/met0000425

Meyer, C., Taranis, L., Goodwin, H., & Haycraft, E. (2011). Compulsive exercise and eating disorders. *European Eating Disorders Review*, *19*(3), 174–189.

Milfont, T. L., & Fischer, R. (2010). Testing measurement invariance across groups: Applications in cross-cultural research. *International Journal of Psychological Research*, *3*(1), 111–130.

Monteiro, R. P., de Holanda Coelho, G. L., Hanel, P. H., de Medeiros, E. D., & da Silva, P. D. G. (2021). The Efficient Assessment of Self-Esteem: Proposing the Brief Rosenberg Self-Esteem Scale. *Applied Research in Quality of Life*, *4*, 1–17.

Morgan, W. P., Brown, D. R., Raglin, J. S., O'Connor, P. J., & Ellickson, K. A. (1987). Psychological monitoring of overtraining and staleness. *British Journal of Sports Medicine*, *21*(3), 107–114.

Mountjoy, M., Sundgot-Borgen, J., Burke, L., Carter, S., Constantini, N. W., Lebrun, C., Meyer, N., Sherman, R., Steffen, K., Budgett, R., & Ljungqvist, A. (2014). The IOC consensus statement: beyond the Female Athlete Triad - Relative Energy Deficiency in Sport (RED-S). *British Journal of Sports Medicine*, *48*(7), 491–497.

Muscat, A. C., & Long, B. C. (2008). Critical comments about body shape and weight: Disordered eating of female athletes and sport participants. *Journal of Applied Sport Psychology*, *20*(1), 1–24.

Nattiv, A., Loucks, A. B., Manore, M. M., Sanborn, C. F., Sundgot-Borgen, J., & Warren, M. P. (2007). The female athlete triad special communications: position stand. *Med Sci Sports Exerc*, *39*(10), 1867–1882.

Palermo, M., & Rancourt, D. (2019). An identity mis-match? The impact of self-reported competition level on the association between athletic identity and disordered eating behaviours. *Eating Behaviors*, *35*, 101341.

Pallant, J. (2010). *SPSS survival manual: A step by step guide to data analysis using SPSS.* Open University Press.

Petrie, T., & Greenleaf, C. (2007). Eating disorders in sport: From theory to research to intervention. In G. Tenenbaum & R. C. Ecklund (Eds.), *Handbook of Sport Psychology* (pp. 352–378). John Wiley.

Petrie, T., & Greenleaf, C. (2012). Eating Disorders in Sport. In S. M. Murphy (Ed.), *The Oxford Handbook of Sport and Performance Psychology* (pp. 635–659). Oxford University Press.

Plateau, C. R., Arcelus, J., & Meyer, C. (2017). Detecting eating psychopathology in female athletes by asking about exercise: use of the Compulsive Exercise Test. *European Eating Disorders Review*, *25*(6), 618–624.

Plateau, C. R., McDermott, H. J., Arcelus, J., & Meyer, C. (2014). Identifying and preventing disordered eating among athletes: Perceptions of track and field coaches. *Psychology of Sport and Exercise*, *15*(6), 721–728.

Riley, A., & Smith, A. (2011). Perceived coach-athlete and peer relationships of young athletes and self-determined motivation for sport. *International Journal of Sport Psychology*, *42*(1), 115–133.

Rodgers, R. F., Slater, A., Gordon, C. S., McLean, S. A., Jarman, H. K., & Paxton, S. J. (2020). A biopsychosocial model of social media use and body image concerns, disordered eating, and muscle-building behaviors among adolescent girls and boys. *Journal of Youth and Adolescence*, *49*(2), 399–409.

Rosenberg, M. (1965). Rosenberg self-esteem scale (RSE). *Acceptance and Commitment*

Therapy. Measures Package, *61*, 61–62.

Scott, C. L., Haycraft, E., & Plateau, C. R. (2019a). Teammate influences and relationship quality are associated with eating and exercise psychopathology in athletes. *Appetite*, *143*(12), 104404.

Scott, C. L., Haycraft, E., & Plateau, C. R. (2019b). Teammate influences on the eating attitudes and behaviours of athletes: A systematic review. *Psychology of Sport and Exercise*, *43*(7), 183–194.

Scott, C. L., Haycraft, E., & Plateau, C. R. (2021). The influence of social networks within sports teams on athletes' eating and exercise psychopathology: A longitudinal study. *Psychology of Sport and Exercise*, *52*, 101786.

Scott, C. L., Plateau, C. R., & Haycraft, E. (2020). Teammate influences, psychological well-being, and athletes' eating and exercise psychopathology: A moderated mediation analysis. *International Journal of Eating Disorders*. https://doi.org/10.1002/eat.23222

Shanmugam, V., Jowett, S., & Meyer, C. (2012). Eating psychopathology amongst athletes: Links to current attachement styles. *Eating Behaviors*, *13*(1), 5–12.

Shanmugam, V., Jowett, S., & Meyer, C. (2013). Eating psychopathology amongst athletes: The importance of relationships with parents, coaches and teammates. *International Journal of Sport and Exercise Psychology*, *11*(1), 24–38.

Shanmugam, V., Jowett, S., & Meyer, C. (2014). Interpersonal difficulties as a risk factor for athletes' eating psychopathology. *Scandinavian Journal of Medicine & Science in Sports*, *24*(2), 469–476.

Sheehan, R., Herring, M., & Campbell, M. (2018). Longitudinal relations of mental health and motivation among elite student-athletes across a condensed season: Plausible influence of academic and athletic schedule. *Psychology of Sport and Exercise*, *37*(7), 146–152.

Shroff, H. (2004). *An examination of peer-related risk and protective factors for body image disturbance and disordered eating among adolescent girls* [Doctoral Dissertation, University of South Florida]. https://scholarcommons.usf.edu/etd/1249/

Singh, S., & Singh, M. (2021). Exercise Dependence Differences Among College Level Female Players and Non-Players. *European Journal of Molecular & Clinical Medicine*, *7*(8), 4963–4968.

Smith, A., & Petrie, T. (2008). Reducing the risk of disordered eating among female athletes: A test of alternative interventions. *Journal of Applied Sport Psychology*, *20*(4), 392–407.

Smith, P., & Ogle, J. (2006). Interactions among high school cross-country runners and coaches: Creating a cultural context for athletes' embodied experiences. *Family and Consumer Sciences Research Journal*, *34*(3), 276–307.

Snijders, T., & Bosker, R. J. (2011). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. Sage.

Stice, E. (1998). Modeling of eating pathology and social reinforcement of the thin-ideal predict onset of bulimic symptoms. *Behaviour Research and Therapy*, *36*(10), 931–944.

Stice, E. (2002). Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychological Bulletin*, *128*(5), 825–848.

Stice, E., & Bearman, S. K. (2001). Body-image and eating disturbances prospectively predict increases in depressive symptoms in adolescent girls: a growth curve analysis. *Developmental Psychology*, *37*(5), 597–607.

Stoyel, H., Delderfield, R., Shanmuganathan-Felton, V., Stoyel, A., & Serpell, L. (2021). A qualitative exploration of sport and social pressures on elite athletes in relation to disordered eating. *Frontiers in Psychology*, *12*, 633490.

Stoyel, H., Shanmuganathan-Felton, V., Meyer, C., & Serpell, L. (2020). Psychological risk indicators of disordered eating in athletes. *Plos One*, *15*(5), e0232979.

Sundgot-Borgen, J., & Garthe, I. (2011). Elite athletes in aesthetic and Olympic weight-class sports and the challenge of body weight and body compositions. *Journal of Sports Sciences*, *29*(sup1), S101–S114.

Sundgot-Borgen, J., & Larsen, S. (1993). Pathogenic weight-control methods and self-reported eating disorders in female elite athletes and controls. *Scandinavian Journal of Medicine & Science in Sports*, *3*(3), 150–155.

Thompson, A., Petrie, T., & Anderson, C. (2017). Eating disorders and weight control behaviours change over a collegiate sport season. *Journal of Science & Medicine in Sport*, *20*(9), 808–813.

Turton, R., Goodwin, H., & Meyer, C. (2017). Athletic identity, compulsive exercise and eating psychopathology in long-distance runners. *Eating Behaviors*, *26*(8), 129–132.

Voelker, D., Petrie, T., Huang, Q., & Chandran, A. (2019). Bodies in Motion: An empirical evaluation of a program to support positive body image in female collegiate athletes. *Body Image*, *28*(3), 149–158.

Voelker, D., Petrie, T., Neumann, C., & Anderson, C. (2016). Psychosocial factors as longitudinal predictors of bulimic symptomatology among female collegiate athletes. *Psychology of Sport and Exercise*, *26*(9), 123–129.

Walton, C. C., Rice, S., Gao, C. X., Butterworth, M., Clements, M., & Purcell, R. (2021). Gender differences in mental health symptoms and risk factors in Australian elite athletes. *BMJ Open Sport & Exercise Medicine*, *7*(1), e000984.

Weber, S., Puta, C., Lesinski, M., Gabriel, B., Steidten, T., Bar, K., Herbsleb, M., Granacher, U., & Gabriel, H. (2018). Symptoms of anxiety and depression in young athletes using the Hospital Anxiety and Depression Scale. *Frontiers in Physiology*, *9*(182), 1–12.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, *67*(6), 361–370.

Table 1.

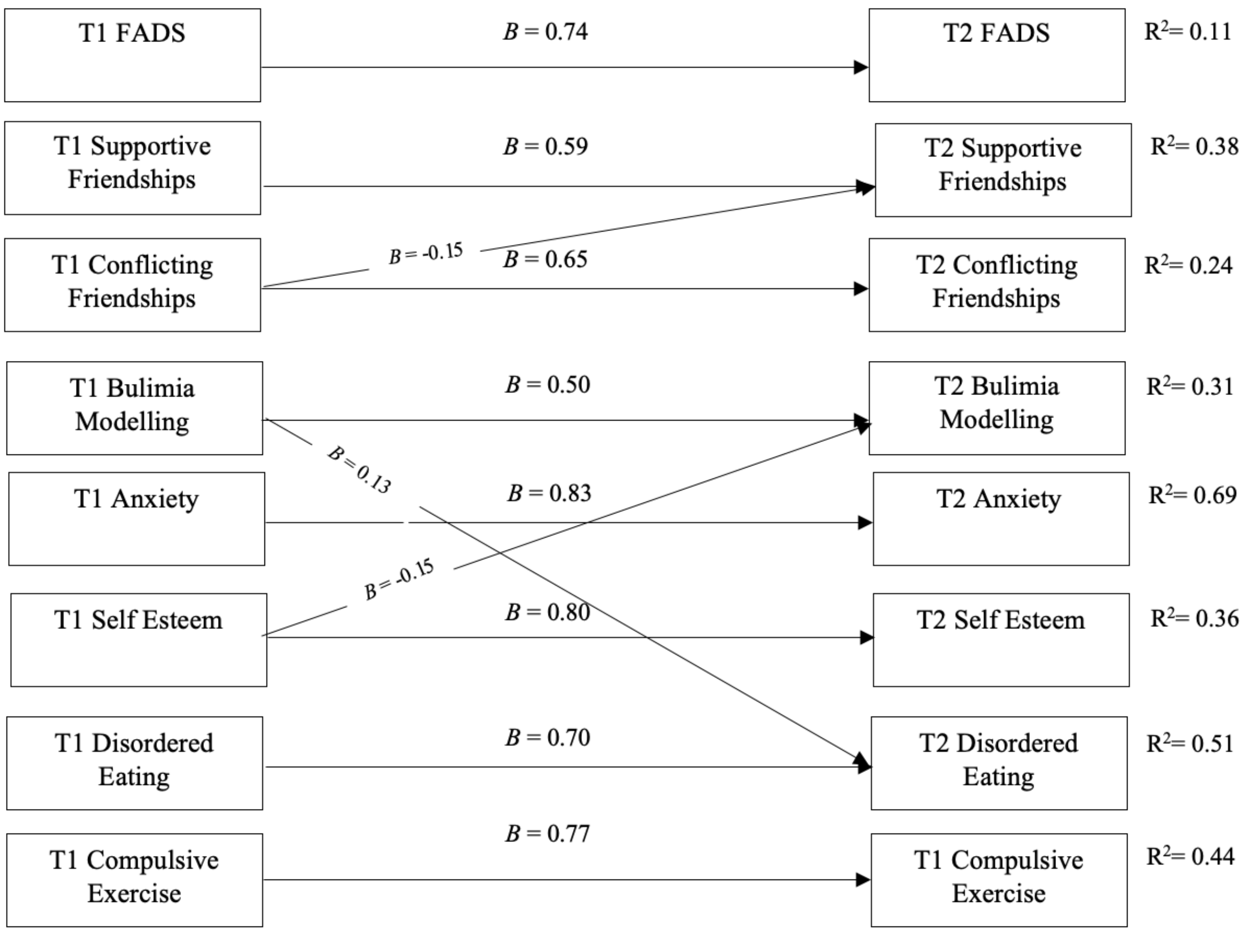
Descriptive statistics at baseline (T1) and follow up (T2) and tests of difference for teammate factors, psychological wellbeing variables and eating/exercise psychopathology variables (N=311)

Measure	T1 Mean (SD)	T1 Omega (ωh)	T2 Mean (SD)	T2 Omega (ωh)	Wilcoxon T-Test
Anti-dieting Advice (FADS)	7.83 (2.95)	0.72 [95%CI=0.65, 0.78]	7.73 (3.00)	0.75 [95%CI=0.68-0.80]	Z= -0.38, p=0.71, r=0.02
Bulimia Modelling (BMS)	1.78 (0.68)	0.75 [95%CI=0.68-0.80]	1.81 (0.69)	0.79 [95%CI=0.74-0.83]	Z= -0.88, p=0.38, r=0.05
Supportive Friendships (SSQRI-S)	2.71 (0.70)	0.87 [95%CI=0.85-0.90]	2.76 (0.66)	0.86 [95%CI=0.83-0.88]	Z= -1.60, p=0.11, r=0.09
Conflicting Friendships (SSQRI-C)	1.33 (0.43)	0.83 [95%CI=0.78-0.87]	1.39 (0.50)	0.89 [95%CI=0.86-0.92]	Z= -2.01, p=0.04, r=0.11
Self-Esteem (B-RSES)	15.47 (2.70)	0.79 [95%CI=0.73-0.83]	15.36 (2.80)	0.79 [95%CI=0.73-0.82]	Z= -1.08, p=0.28, r=0.06
Disordered Eating (EDI-VS)	2.42 (2.78)	0.62 [95%CI=0.50-0.71]	2.09 (2.62)	0.65 [95%CI=0.53-0.74]	Z= -2.93, p<0.001, r=0.16
Compulsive Exercise (CET-A)	7.33 (2.81)	0.86 [95%CI=0.83-0.88]	7.30 (2.93)	0.89 [95%CI=0.87-0.91]	Z= -0.62, p=0.54, r=0.04
Anxiety (HADS-A)	7.03 (3.43)	0.77 [95%CI=0.72-0.81]	7.82 (3.28)	0.76 [95%CI=0.72-0.80]	Z= -6.53, p<0.001, r=0.37

Note. FADS=Friends Anti-dieting Scale, BMS=Bulimia Modelling Scale, SSQRI-S=Sport Specific Quality of Relationship Inventory-Support, SSQRI-C=Sport Specific Quality of Relationship Inventory-Conflict, B-RSES=Brief-Rosenberg's Self-Esteem Scale, EDI-VS=Eating Disorder Inventory-Very Short, CET-A=Compulsive Exercise Test-Athlete, HADS-A=Hospital Anxiety and Depression Scale - Anxiety

Figure 1.

Structural equation model of the cross-lagged panel analysis of T1-T2 teammate factors, psychological wellbeing variables and eating/exercise psychopathology variables (N=311).



Note. All pathway coefficients are standardised and significant at $p<0.001$. T1=Time 1, T1=Time 2 (4 months later). All pathways tested, only significant pathways reported.

Supplementary information

Table S1.

A series of measurement models to confirm the factor structure and reliability of study variables at baseline (T1) and follow up (T2) N=311

Measure	Time point	χ2	*df*	*p*	CFI	RMSEA	SRMR	AIC	Omega
Friends Anti-Dieting Scale (FADS)	T1	8.05	5	0.15	0.99	0.04 [90%CI=0.00,0.10]	0.02	28.05	*ωh*=0.72 [95%CI=0.65, 0.78]
	T2	25.29	5	<0.001	0.95	0.11 [90%CI=0.07, 0.16]	0.03	45.29	*ωh*=0.75 [95%CI=0.68-0.80]
Sport-Specific Quality of Relationship Inventory (SSQRI)	T1	109.71	53	<0.001	0.97	0.06 [90%CI=0.04-0.07]	0.02	159.71	Support: *ωh*=0.87 [95%CI=0.85-0.90] Conflict: *ωh*=0.83 [95%CI=0.78-0.87]
	T2	130.64	53	<0.001	0.96	0.07 [90%CI=0.05-0.08]	0.03	180.64	Support: *ωh*=0.86 [95%CI=0.83-0.88] Conflict: *ωh*=0.89 [95%CI=0.86-0.92]
Bulimia Modelling Scale (BMS)	T1	15.64	2	<0.001	0.95	0.15 [90%CI=0.09, 0.22]	0.03	31.64	*ωh*=0.75 [95%CI=0.68-0.80]
	T2	19.52	2	<0.001	0.95	0.17 [90%CI=0.11, 0.24]	0.03	35.52	*ωh*=0.79 [95%CI=0.74-0.83]
Brief – Rosenberg Self-Esteem Scale (B-RSES)	T1	45.77	5	<0.001	0.91	0.16 [90%CI=0.12,0.21]	0.03	65.77	*ωh*=0.79 [95%CI=0.73-0.83]
	T2	51.04	5	<0.001	0.90	0.17 [90%CI=0.13, 0.22]	0.03	71.04	*ωh*=0.79 [95%CI=0.73-0.82]
Hospital Anxiety and Depression Scale – Anxiety (HADS-A)	T1	28.23	14	0.01	0.97	0.06 [90%CI=0.03,0.09]	0.02	56.23	*ωh*=0.77 [95%CI=0.72-0.81]
	T2	33.50	14	0.002	0.96	0.07 [90%CI=0.04, 0.10]	0.02	61.50	*ωh*=0.76 [95%CI=0.72-0.80]
Eating Disorder Inventory – Very Short (EDI-VS)	T1	13.90	7	0.05	0.97	0.06 [90%CI=0.00, 0.10]	0.02	41.90	*ωh*=0.62 [95%CI=0.50-0.71]
	T2	30.30	7	<0.001	0.92	0.10 [90%CI=0.07, 0.14)	0.03	58.30	*ωh*=0.65 [95%CI=0.53-0.74]
Compulsive Exercise Test – Athlete (CET-A)	T1	134.48	51	<0.001	0.95	0.07 [90%CI=0.06, 0.09]	0.10	188.48	*ωh*=0.86 [95%CI=0.83-0.88]
	T2	236.31	51	<0.001	0.92	0.10 [90%CI=0.09. 0.12]	0.12	290.31	*ωh*=0.89 [95%CI=0.87-0.91]

Note. χ2=Chi Square, *df*=degrees of freedom, CFI=Comparative Fit Index, SRMR=Standardised Root Mean Square Residual, RMSEA=Root Mean Square Error of Approxiation

Table S2.

Spearman's correlations between BMI, teammate factors, self-esteem, anxiety, disordered eating and compulsive exercise at baseline (N=311)

	BMI	FADS	BMS	SSQRI-S	SSQRI-C	B-RSES	HADS-A	EDI-VS	CET-A
BMI	-	0.06	0.09	0.03	0.07	0.08	-0.11	0.07	-0.15
FADS		-	**0.48**	0.18	**0.25**	-0.03	0.09	0.17	**0.19**
BMS			-	0.14	**0.31**	**-0.19**	**0.22**	**0.33**	**0.20**
SSQRI-S				-	-0.02	**0.21**	-0.10	-0.10	0.07
SSQRI-C					-	-0.03	0.16	0.11	0.03
B-RSES						-	**-0.51**	**-0.33**	-0.10
HADS-A							-	**0.32**	**0.19**
EDI-VS								-	**0.35**
CET-A									-

Note. p<0.001 highlighted in bold; FADS=Friends Anti-dieting Scale, BMS=Bulimia Modelling Scale, SSQRI-S=Sport Specific Quality of Relationship Inventory-Support, SSQRI-C=Sport Specific Quality of Relationship Inventory-Conflict, B-RSES=Brief-Rosenberg's Self-Esteem Scale, EDI-VS=Eating Disorder Inventory-Very Short, CET-A=Compulsive Exercise Test-Athlete, HADS-A=Hospital Anxiety and Depression Scale – Anxiety

Table S3.

Gender model fit indices across various model constraints

Model	χ2	*df*	*p*	CFI	RMSEA	SRMR	AIC
Unconstrained	146.10	96	0.001	0.97	0.04 [90%CI=0.03, 0.05]	0.16	498.17
Structural weights	163.17	107	<0.001	0.97	0.04 [90%CI=0.03, 0.05]	0.20	493.17
Structural covariances	259.51	148	<0.001	0.94	0.05 [90%CI=0.04, 0.06]	0.57	507.87
Structural residuals	344.87	184	<0.001	0.92	0.05 [90%CI=0.04, 0.06]	0.61	520.87

Table S4.

Sport type model fit indices across various model constraints

Model	χ2	*df*	*p*	CFI	RMSEA	SRMR	AIC
Unconstrained	149.04	96	<0.001	0.97	0.04 [90%CI=0.03, 0.06]	0.16	501.04
Structural weights	164.71	107	<0.001	0.97	0.04 [90%CI=0.03, 0.05]	0.16	494.71
Structural covariances	244.39	148	<0.001	0.95	0.05 [90%CI=0.04, 0.06]	0.31	492.39
Structural residuals	316.49	184	<0.001	0.93	0.05 [90%CI=0.04, 0.06]	0.36	492.49

Table S5.

Age group model fit indices across various model constraints

Model	χ2	*df*	*p*	CFI	RMSEA	SRMR	AIC
Unconstrained	121.34	94	0.04	0.99	0.03 [90%CI=0.01, 0.04]	0.17	473.34
Structural weights	134.05	107	0.04	0.99	0.03 [90%CI=0.01, 0.04]	0.21	464.05
Structural covariances	219.32	148	<0.001	0.96	0.04 [90%CI=0.03, 0.05]	0.28	467.32
Structural residuals	268.57	184	<0.001	0.96	0.04 [90%CI=0.03, 0.05]	0.29	444.57