Abstract

Participation in sport can paradoxically be a source of psychological needs-satisfaction and psychological needs-frustration. Self-Determination Theory was applied to explain temporal relationships between athletes' psychological needs-satisfactions and psychological needs-frustrations and burnout, through a two-wave longitudinal study. Participants included 184 athletes (*M* age = 24.04 years, *SD* = 5.56, 67.9% male) representing a range of competitive levels. A latent difference scores model specifying longitudinal relationships between burnout and needs-satisfactions and needs-frustrations was tested. Significant within-variable changes were observed for all needs-satisfaction and needs-frustration variables. Longitudinal associations were found in Models 3 (autonomy-frustration) and 6 (relatedness-satisfaction). Higher burnout at baseline predicted an increase in autonomy-frustration ($\beta = .13$, $p < .05$), whereas higher relatedness-satisfaction at baseline reduced burnout levels later in the season ($\beta = -.22$, $p < .001$). To conclude, continuous tracking of athlete burnout levels and fostering of needs-supportive climates that minimise autonomy-controlling behaviors is recommended for the burnout prevention in athletes.

Keywords: Self-determination theory; sport; need satisfaction; need frustration; well-being; mental health.

According to Keyes (2005), mental health encompasses two distinct but correlated continuums: ill-being (or mental illness) and well-being (or mental health). Mental health can be measured at global (i.e., day-to-day), contextual (e.g., sport) and situational (i.e., here and now) levels (Lundqvist, 2011; Vallerand, 2007). Applied as a contextual measure of ill-being in sport, burnout is a commonly experienced negative psychological syndrome, encompassing three symptoms: (i) emotional and physical exhaustion, (ii) a reduced sense of accomplishment, and (iii) the development of a cynical attitude towards the once favored sport (Raedeke, 1997). Burnout has several deleterious consequences including depressed mood, impaired social relationships, decreased performance, and temporary or permanent sport withdrawal (Gustafsson et al., 2017). While challenges remain regarding the diagnostic ability of burnout instruments (Gerber et al., 2018), it is estimated that approximately 10% of athletes experience burnout at any one point in time (Madigan, 2021).

Burnout is a syndrome that develops over time, insofar as symptoms can be acute and cease quickly. However, serious issues may arise with increased symptom severity, impacting an athlete's daily life, and in some circumstances may require a prolonged period of physical and mental recovery (Gustafsson et al., 2017). Due to intense periods of competition and performance stress throughout a season, athletes can experience burnout fluctuations that may pose increased risks to their well-being (Cresswell & Eklund, 2006). For example, multiple and often unforeseen stressors such as injury, income/funding loss and non-selection can occur, thereby increasing burnout and subsequent ill-being (Giles et al., 2020). Equally, foreseen issues such as competitive loss or lack of individual/team progression and increased training/competition load may increase risk of burnout (Madigan, 2021). To effectively capture the athletic experience during such circumstances, longitudinal and theoretically grounded studies of burnout risk factors are warranted (Madigan et al., 2019).

Specifically, longitudinal studies can benefit athlete burnout research because the temporal nature of burnout syndrome development can be specified alongside multiple constructs. In doing so, both predictive (i.e., a change in one variable predicts a change in burnout) and/or reciprocal (i.e., a change in burnout accompanies a change in the same variable predicting burnout) effects can be studied (Lonsdale & Hodge, 2011). For example, competence at time 1 predicting change in burnout, while burnout at time 1 predicting change in competence satisfaction, would suggest a reciprocal relationship in the current study (See Figure 1). Predictive and reciprocal effects show a trajectory of change over time, and therefore can offer potential casual explanations that a prior level of, or a change in one variable, leads to a change in another (Howardson et al., 2017). Some previous studies (e.g., Balaguer et al., 2012; Hancox et al., 2017; Sheehan et al., 2018, Stenling et al., 2015) have commendably used a longitudinal design, and additional theoretical studies have examined perfectionism (Madigan et al., 2015), coping tendencies (Madigan et al., 2020), and self-determined motivation (Cresswell & Eklund, 2006; Lonsdale & Hodge, 2011), showing significant relationships with burnout.

Focusing on the concept of motivation, Self-Determination Theory (SDT; Ryan & Deci, 2000), is a meta-theory of human motivation, behavior and health, specifying that the origins of self-determined motivation derive from one's basic needs to experience the satisfaction of autonomy (i.e., provision of choice, volitional behavior), competence (i.e., feelings of effectiveness) and relatedness (i.e., sense of belongingness) (see Basic Psychological Needs Theory [BPNT], Ryan & Deci, 2008). Importantly, psychological needs receive varied levels of support and control from significant others (e.g., coaches) in an athlete's prevailing social context. In BPNT, Ryan and Deci (2008) formally hypothesise that perceptions of need satisfaction/frustration and motivation predict mental health outcomes such as burnout.

Applying an SDT perspective on the aetiology of burnout and confirmed in the broader research field of sport and exercise psychology, needs-supportive social environments predict needs satisfaction, whereas controlling environments predict needs frustration (Matosic et al., 2016; Ntoumanis et al., 2017). Throughout a competitive season for example, a needs-supportive coach, teammate, and/or member of support staff may encourage and support development (e.g., competence-support), offer input and choice (e.g., autonomy-support), and offer a warm regard for the athlete (e.g., relatedness-support). Equally, however, perceived needs-controlling social agents may denigrate the athlete (e.g., competence-control), dismiss their input (e.g., autonomy-control) and/or be distant and cold towards the athlete (e.g., relatedness-control). Moreover, experiences of success/failure, injury and recognition (e.g., awards) can exert a role in needs-satisfaction and needs-frustration (Ntoumanis et al., 2018). Earlier cross-sectional research established that such features of this athletic experience likely protect from, or increase risk of burnout, accordingly, however given the cross-sectional design, reverse causality could not be rejected (Bartholomew et al., 2011a; Bartholomew et al., 2011b). Although further systematic review evidence (Li et al., 2013), and some preliminary longitudinal research (Hancox et al., 2017; Quested & Duda, 2011) has indicated that burnout is inversely associated with needs satisfaction, and positively associated with needs frustration (Hancox et al., 2017), Gerber et al. (2018) and others (Madigan, 2021) have emphasized that due to analytical and/or study design limitations, it remains equally plausible that burnout exerts a reciprocal role in the satisfaction or frustration of basic psychological needs. As such, while the directionality of the needs-satisfaction/frustration and burnout relationship is hypothesized linearly in SDT's casual chain, the testing of reciprocal and/or reverse causality effects require a more comprehensive, methodologically thorough testing across multiple timepoints.

One way to achieve reciprocal testing of such relationships is to employ Latent Difference Score Modelling (LDSM). Specifically, LDSM can allow for the assessment of within-individual change of variables such as burnout and needs-satisfaction/frustration between adjacent time points (e.g., beginning and middle of a competitive season), and individual differences in such changes, as well as the dynamic relationships between those constructs (Chen et al., 2018; Mund & Nestler, 2019). While authors applying LDSM approaches to burnout are increasingly common, the majority of existing researchers have relied on the use of cross-lagged panel models or linear regression that do not allow for an assessment of cross-construct 'changes to changes' relationships (Madigan, 2021).

To our best knowledge, no studies have examined whether temporal changes in needs-satisfaction/frustration link with changes in burnout, and vice versa through an LDSM approach. Hence, the aim of the present study was to test an SDT model specifying temporal change relationships between athletes' psychological needs and burnout across a competitive sporting season using LDSM.

Hypotheses tested

We hypothesized that due to within-season changes, individual psychological needs-satisfactions or psychological needs-frustrations (i.e., competence, autonomy, and relatedness) at timepoint 1 would predict a within-variable latent change (Δ), controlling for the relationship between adjacent raw timepoint 1 and 2 scores (Hypothesis 1, H_1) (e.g., competenceT1 > Δcompetence; controlling for competenceT1> competenceT2). As athletes' competitive experiences vary widely, we did not specify any direction of change, such that both negative and positive associations were expected. We expected a latent change in Δburnout in Hypothesis 2 (H_2), again not specifying any direction of association. Then, focusing on variable-to-variable changes, we hypothesized that individual needs satisfactions and frustrations at timepoint 1 would negatively and positively predict Δburnout, respectively

(Hypothesis 3, H_3), controlling for the aforesaid relationships. Lastly, while SDT clearly specifies burnout as an outcome of needs satisfactions and frustrations, we explored the fourth hypothesis that burnout at timepoint 1 would, respectively, negatively and positively predict individual Δneeds-satisfactions and Δneeds-frustrations (Hypothesis 4, H_4), controlling for the aforementioned relationships.

Methods

Inclusion criteria, recruitment, procedure and participants

Ethical approval was granted by the lead author's academic institution, and informed consent and being ≥18 years old were within the ethical conditions. Participants confirmed their athlete status through a widely used item (Shannon et al., 2021) consistent with the definition of sport, namely, 'are you an athlete involved in a structured, competitive physical activity?' (Rejeski & Brawley, 1988). Recruitment strategies involved sending an email invitation to sports clubs across Ireland and the United Kingdom, survey links distributed on Twitter and social media outlets, and SMS/WhatsApp messages to sports team coaches, captains and players to share and forward (i.e., snowball sampling). The online survey took approximately nine minutes to complete, and comprised demographic questions (i.e., gender, age) and sporting factors (i.e., sport type, average training and competition hours per-week, level of competition [i.e., elite, sub-elite, amateur]; Lonsdale et al., 2009), alongside psychometric scales (see below).

Data were collected between May 2018 to May 2019 through an encrypted online questionnaire using SurveyMonkey software. Data obtained from online surveys have shown consistent factorial validity with paper-based studies, and have shown the added benefit of minimising attrition and false responses (Lonsdale et al., 2006). To ensure a valid window for capturing temporal changes, we applied past research recommendations suggesting a 12-week period for the aetiology of athlete burnout symptoms (Gustafsson et al., 2018; Lonsdale

et al., 2009). As such, data were collected in two separate timepoints (i.e., baseline = week 0; post = 12 weeks following baseline), and email reminders were sent to all consenting participants. Following the two waves of data collection, participants' data were matched through unique participant identifier codes. To ensure that any possible changes took place because of sporting participation, those athletes reporting their participation as 'off-season' or 'pre-season' at one or more timepoints were excluded.

Subsequently, a total of 605 athletes completed baseline measures, and 184 athletes completed the two waves of data collection, resulting in a 30.4% retention rate. There were no significant baseline differences on the study outcomes among those athletes with one or two waves of completed data ($p > .05$). Among the 184 athletes with two waves of data, the mean age was 24.04 years ($SD = 5.56$) and included 67.9% males. Ninety four percent of the sample took part in interactive team sports, whereas 6% participated in individual sports. Sixty seven percent reported their competitive level as amateur (i.e., local/county leagues), 25% were semi-elite (i.e., semi-professional, regional or country representative), 1% elite (i.e., professional, international), and 7% recreational (i.e., low-level participation). The mean duration of training was 6.74 hours ($SD = 2.42$) per week, whereas competition amounted 2.84 hours ($SD = 1.91$) per week. 9.8% of the sample reported a recent injury at timepoint 2.

Outcome variables

Psychological needs satisfaction and frustration

The adapted 18-item Need Satisfaction and Frustration Scale (NSFS; Longo et al., 2016) was completed by participants. All items were scored on a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7). The scale incorporates six 3-item subscales for each psychological need satisfied/frustrated, and mean scores were produced accordingly. Example items include: *In my sport*…'I feel very close and connected with other people' (i.e., relatedness satisfaction), and 'I feel a bit alone when with other people' (i.e., relatedness

frustration). Higher scores indicate increased levels of needs satisfaction/frustration (Longo et al., 2016), and a previous study among athletes (Shannon et al., 2021) found factorial validity support for a 6-factor model wherein individual psychological needs satisfied/frustrated can be isolated for analyses. In the present study, Cronbach's alpha (α) for baseline and follow-up were as follows: competence satisfaction (α = .89 and .89); competence frustration (α = .85 and .87); relatedness satisfaction (α = .84 and .89); relatedness frustration (α = .87 and .90); autonomy satisfaction (α = .71 and .90); autonomy frustration (α = .72 and .75).

Athlete burnout

Athlete burnout was assessed through the 15-item Athlete Burnout Questionnaire (ABQ; Raedeke & Smith, 2001), a valid and psychometrically robust measure of burnout (Gustafsson et al., 2018). Items were scored on a 5-point Likert scale ranging from 1 (Almost never) to 5 (Almost Always). Mean scores were produced for each of the three factors of emotional and physical exhaustion (e.g., "I feel overly tired from my sports participation"), reduced sense of accomplishment (e.g., "I'm not achieving much in sport") and sport devaluation (e.g., "I have negative feelings towards sport") are included (Gustafsson et al., 2016). A composite burnout factor was calculated, with the subfactors treated as observed variables, and higher scores reflected increased presence of burnout (Gerber et al., 2018). Cronbach's alpha values were α = .88 for baseline and α = .90 at follow-up in the present study.

Data management and statistical analysis

Raw data were transferred from SurveyMonkey software (Palo Alto, CA) into SPSS (Version 25; IBM Corp, NY). Two of the research team cleaned the data, inspected outliers, and then confirmed that all variables displayed acceptable skewness and kurtosis statistics. Missing data (ranging from 2-5% on study outcomes), were found to be missing completely at random (MCAR), based on Little's MCAR test result ($p > .05$), allowing the use of the Expectation

Maximisation (EM) algorithm with intercorrelated items to inform replacement of any missing data with EM imputed values (Field, 2013). Prior to the main analyses, descriptive statistics for timepoint 1 and timepoint 2 variables were estimated in Table 1, wherein averaged variable scores were produced. Moreover, Table 2 included bivariate correlations of the study variables at baseline and timepoint 2.

Latent Difference Scores Model

The LDSM enabled testing of the study hypotheses examining temporal changes, both within persons, and across study variables (Ferrer & McCardle, 2010). In the present two-wave LDSM study, a latent difference variable (i.e., 'Δ') represents the difference between variables measured on adjacent timepoints of baseline (e.g., Competence Satisfaction-week 0) and follow-up (e.g., Competence Satisfaction-week 13), corrected for measurement error (Stenling et al., 2015). A total of six structural equation models were formulated on the basis of each individual psychological need satisfied/frustrated acting as the predictor variable, with burnout representing the outcome variable.

As displayed in Figure 1, the standardised beta (β) coefficients relating to paths between timepoint 2 and baseline, and from timepoint 2 and the latent change score, are constrained to 1. Applying this method means that the latent change variable (i.e., ΔCompetence Satisfaction) variable absorbs the within-person changes from one time to the next (Howardson et al., 2017). All variables measured at baseline were allowed to covary, as were latent difference scores of the Needs Satisfactions/Frustrations and Burnout variables. Thereafter, β coefficients were specified from baseline scores of the predictor variable (i.e., Competence Satisfaction) onto the outcome variable (i.e., ΔBurnout), whilst including a β coefficient from the baseline score of the outcome variable (i.e., Burnout) onto the latent difference score of the predictor variable (i.e., ΔCompetence Satisfaction). A statistically significant pathway between a baseline predictor variable score to an external variable's latent change score represents evidence of a

one-way (e.g., Higher Competence Satisfaction at baseline predicts reduced Burnout over time) association, whereas significant paths in both directions represents a reciprocal (e.g., Burnout at baseline predicts ΔCompetence Satisfaction whilst Competence at baseline predicts ΔBurnout) association over time (Chen et al., 2018).

Goodness-of-fit indices recommended by Hu and Bentler (1999) were used to assess the adequacy of the difference score model. The comparative fit index (CFI), and the Tucker-Lewis Index (TLI) were reported, with values of > .90 deemed acceptable, and > .95 as good-to-excellent. The root mean square error of approximation (RMSEA) was reported, with < 0.08 considered adequate model fit. We also included the Chi-Square ($\chi 2$) statistic, but approached with caution given the Likert-scaled nature of our data, and sample size sensitivities. Gender (i.e., male/female), recent injury (i.e., Yes/No) and sport type (i.e., individual/team) (Lonsdale et al., 2009) were included as statistical controls. Figures with evidence of longitudinal relationships were produced specifying standardized beta (β) coefficient values for each direct path, and R^2 values related to the proportion of total variance predicted on the latent difference variables. Bollen-Stine bootstrapping was conducted with 5000 samples to improve the accuracy of parameter estimates and fit indices (Byrne, 2001), and 95% confidence intervals (CI's) were produced for significant effects.

Insert Figure 1: *Hypothesized latent change score Model 1 including competence satisfaction and burnout as predictor and outcome variables*

Results

Descriptive statistics

Table 1 presents the mean and standard deviation scores for the study outcomes at adjacent timepoints. The sample's mean burnout levels were slightly below (2.48) and above (2.51) the mid-point of 2.50 in the Likert scale response format at baseline and follow-up, respectively, suggesting the presence of burnout 'sometimes' among the sample. In terms of a mid-point of 3.50 in the Likert scale response format all mean sample needs satisfaction scores were above this threshold at both timepoints, and relatedness frustration was below, suggesting moderate-to-high levels of needs satisfaction, and low levels of relatedness-frustration throughout. However, mean autonomy frustration levels were above 3.50 value at both timepoints, and competence frustration was close (i.e., baseline = 3.34 and follow-up = 3.39), indicating a regular experience of these frustrations throughout.

The correlation matrix showed a preponderance of significant variable-to-variable associations at baseline, follow-up, and across timepoints. Most relevant for the main analyses, the outcome variable of Burnout at Timepoint 2 was significantly associated with all needs satisfaction and needs frustration variables at timepoint 1, indicating possible evidence of a longitudinal relationship (See Table 2). Relatedly, however, Burnout at timepoint 1 was significantly associated with both competence and relatedness satisfaction and frustration at timepoint 2, indicating the possibility of longitudinal reciprocal relationships (See Table 2).

Latent Difference Scores Models 1-6

The LDSM analyses showed that all models aside from Model 3 (n.b., autonomy frustration) were within the recommended cut-off points for adequate fit outlined by Hu and Bentler (1999) (see Table 3). Modification indices for Model 3 presented a solution, including the estimation of a covariance path with item 2 at timepoint 1 to item 3 at timepoint 2. As both

items displayed a similarity in meaning (i.e., 'I feel forced to follow directions' and 'I feel under pressure to follow procedures') a covariance path between the items was added, resulting in an acceptable fitting model (see Table 3).

In Model 1, despite R^2 values of .20 (Δcompetence frustration) and .10 (Δburnout) only H_1 was supported, as competence frustration at timepoint 1 predicted a significant latent negative change in Δcompetence frustration ($\beta = -.43$, $p < .001$), controlling for the relationship between competence frustration at timepoint 1 and competence frustration at timepoint 2.

Likewise, Model 2 showed no significant longitudinal variable-to-variable associations ($H_{3\text{-}4}$), or within-variable changes for burnout (H_2), and only competence satisfaction at timepoint 1 predicted a significant negative latent change in Δcompetence satisfaction ($\beta = -.48$, $p < .001$). Therefore, while competence frustration reduced in model 1, so did competence satisfaction.

Model 3 showed significant negative within-variable latent change in Δautonomy frustration (H_1; $\beta = -.79$, $p < .001$), and Δburnout (H_2; $\beta = -.37$, $p < .001$). Furthermore, while autonomy frustration at timepoint 1 did not predict a latent change in Δburnout (H_3), burnout at timepoint 1 predicted a positive latent change in Δautonomy frustration (H_4; $\beta = .13$, $p < .05$). Therefore, the support for H_4 indicated some evidence of a causal relationship that the significant positive change in autonomy frustration was partly explained by athletes' having higher burnout symptoms at the beginning of a season. The covariation path between the latent difference scores was also positive ($\beta = .30$). Figure 2 illustrates these paths in visual form, and notably significant proportions of variance were explained for latent change in Δautonomy frustration ($R^2 = .59$) and Δburnout ($R^2 = .13$).

Despite sharing conceptual characteristics with autonomy frustration, results for Model 4 (autonomy satisfaction) did not align with Model 4, despite a significant negative

within-variable latent change in Δautonomy satisfaction (H_1; β = -.51, p < .001). As such, the significant latent change in Δautonomy satisfaction was not explained by any prior levels of burnout (H_4). Controlling for the above within-variable and variable-to-variable associations also resulted in a non-significant latent change in Δburnout ($H_{2,3}$).

Model 5 (relatedness frustration) showed some unique findings in that both negative latent changes in Δrelatedness frustration (H_1; β = -.38, p < .001) and Δburnout (H_2; β = -.40, p < .001) were shown. However, these longitudinal changes were not explained by any variable-to-variable associations ($H_{3, 4}$).

Lastly, Model 6 showed some evidence of longitudinal associations such that both negative latent changes in Δrelatedness satisfaction (H_1; β = -.47, p < .001) and Δburnout (H_2; β = -.48, p < .001) were significantly predicted by their respective timepoint 1 values. Further, the significant latent change in Δburnout was inversely associated with prior levels of relatedness satisfaction (H_3; β = -.22, p < .001). Further support was shown in the inverse covariation path of the difference scores (β = -.45). Despite those findings, there was no evidence of the relationship being casually reciprocal, as burnout at timepoint 1 did not significantly predict latent change in Δrelatedness satisfaction (H_2). Model 6 findings are visually depicted in Figure 3.

Insert Table 1: *Study outcome variable mean scores and standard deviations (SD) for timepoint 1 (T1) and timepoint 2 (T2)*

Insert Table 3: *Summary of fit statistics for latent difference scores models 1-6*

Insert Figure 2: *Model 3: LDSM with autonomy frustration and burnout as predictor and outcome variable*

Insert Figure 3: Model 6: *LDSM with relatedness and burnout as predictor and outcome variables*

Discussion

Main findings

This study advanced testing of Self-Determination Theory (Ryan & Deci, 2000) in athlete mental health research by examining temporal changes between athletes' psychological needs and burnout through a two-wave longitudinal design. Significant within-variable negative changes were shown in all needs-satisfaction and needs-frustration variables (supporting H_1), highlighting the differential, orthogonal effect of how sporting participation can both reduce negative experiences of needs-frustration whilst paradoxically also decrease adaptive experiences of psychological needs satisfaction (Isoard-Gautheur et al., 2012; Stenling et al., 2015). Moreover, several models showed significant negative within-variable changes in burnout levels (supporting H_2), indicating that burnout is not an inevitability of sporting participation (Madigan, 2021). Thereafter, our models displayed some evidence of causal links between specific psychological needs satisfactions and frustrations and burnout, to the extent that: (a) higher burnout levels at the beginning of a competitive season predicted an increase in autonomy frustration later in the season (i.e., H_4), and (b) higher levels of relatedness satisfaction at the beginning of a season related to lower levels of burnout later in the season, and offered a protective effect (i.e., H_3). Overall, our findings support the rationale for continuous tracking of athlete burnout levels (Madigan et al., 2021), in addition to fostering needs-supportive climates for enhancing needs satisfaction (Ntoumanis et al., 2018).

Study uptake and descriptive results

The present study employed recruitment through online methods, and consistent with demographic assessments of the sporting population (Vella & Swann, 2021) included a diverse and representative sample of sports participants, allowing for a degree of generalisation. Although the retention rate of 30.4% may be considered low, given the

present study was solely web-based and did not include any recruitment in physical locations or incentives, this figure is relatively high (Sánchez-Fernández et al., 2012). Future efforts to boost retention in likewise studies may consider the personalisation of email reminders, rather than standardized email messages as used in the present study (Sánchez-Fernández et al., 2012).

Given mean scores were shown to be close to or above the mid-point of the Likert scale response format for each respective psychological need at adjacent timepoints, except for relatedness satisfaction, it is arguable that on average, athletes can concomitantly experience needs-satisfaction and needs-frustration in their sport (Bartholomew et al., 2011a). Moreover, the correlation matrix confirmed significant within- and between-timepoint variable relationships, to the extent that burnout at timepoint 2 and 1 was significantly associated with all needs-satisfaction and frustration variables at timepoint 1 and 2. As such, our findings support extant longitudinal research showing associations with burnout and motivational variables during a competitive sporting season where psychological changes invariably occur (Cresswell & Eklund, 2006; Lonsdale & Hodge, 2011). The significant associations also justified the specification of a latent difference scores model to explore evidence of possible causal links (Mund & Nestler, 2019; Myers et al., 2018).

Models tested and implications

Specifying the study variables within separate LDSM models responded to recent calls (Madigan et al., 2021) that athlete burnout research requires advanced statistical methodologies to determine possible evidence of casual links. All six models adequately fitted the data and in several incidences within-variable changes were observed in psychological needs and burnout (supporting $H_{1\text{-}2}$) (Chen et al., 2018). Specifically, all needs satisfaction and needs frustrations decreased in Models 1-6, whilst burnout decreased in Models 3 and 6. Despite the reduction of needs frustration and burnout being a welcomed

finding, the decline of needs-satisfactions was not (Bhavsar et al., 2019). Therefore, a somewhat paradoxical story emerged regarding the athletes' sporting experiences throughout their competitive seasons in this study.

To provide context, our findings suggest that athletes may have perceived a lessening of the frustration of their needs as the season progressed, possibly because as time develops and contact time increases improved communication may be established between teammates, players, and coaches (Bartholomew et al., 2011a; Bhavsar et al., 2019). Further, some athletes begin to internalise their reasons for participating in their sport (i.e., shift from external motivation to identified regulation) and experience an increase in autonomous motivation (Pelletier et al., 2013). Equally, however, as the season progressed athletes likely feel dissatisfied with the extent to which their needs were being met, perhaps in a practical sense, related to negative affect regarding win-loss ratios (Stanley et al., 2021), non-selection, engagement with needs-thwarting social agents (e.g., coaches, teammates, instructors) (Matosic et al., 2016; Shannon et al., 2019; Shannon et al., 2021), and/or a perceived lack of personal and team challenges and development (e.g., stagnation, boredom). These findings reinforce the proposed theoretical differentiation between psychological needs satisfaction and frustration variables and although conceptually related, they are distinct entities (Longo et al., 2016).

Higher burnout at the beginning of the season predicted an increase in autonomy frustration later in the season in Model 3 (supporting H_4) revealing a somewhat paradoxical story. Conceptually, SDT hypothesises a linear link, to the extent that needs-satisfaction/frustration are corollary variables to burnout. However, given burnout predicted an increase in autonomy frustration, the reverse link can be argued, as autonomy frustration refers to a lack of perceived agency in one's behavior (Ryan & Deci, 2017), and burnout involves a reduced sense of one's abilities and accomplishments (Raedeke, 1997). Athlete

burnout measurement tools are widely available (Madigan et al., 2019), and therefore if average scores are close to or above the midpoint on the Likert scale (e.g., 'sometimes-to-always' as reference) early in a season, use of autonomy-supportive behaviors and the minimisation of autonomy-controlling behaviors may be a solution for the future prevention of autonomy frustration (Ntoumanis et al., 2018). In a practical sense, those involved in athlete provision may attempt to highlight and continuously reinforce the importance of an athlete's contribution to the team, encourage initiative, and reduce controlling language (Bechter et al., 2018). Doing so may also prevent the subsequent negative effects of autonomy frustration such as amotivation, ill-being and early drop-out (Bhavsar et al. 2019).

Higher relatedness at the beginning of the season predicted a decrease in burnout later in the season in Model 6, supporting meta-analytical findings of social constructs and burnout that included 10 relatedness-focused studies (Pacewicz et al., 2019). Previous studies applying SDT (e.g., DeFreese & Smith. 2013), have shown that perceived support (regardless of actual received support) from teammates, was inversely correlated with burnout. In practice, athletes who have an established close and reciprocal relationships with their teammates/coaching staff earlier in a season, may have a better capacity to buffer negative effects, and thus functionally adapt to burnout symptoms (Hartley & Coffee, 2019). As a psychological need, relatedness satisfaction may be theoretically viewed as a global positive social construct (Ryan & Deci, 2017). Therefore, positive adaptive social behaviors that follow may include disclosing frustrations to teammates and coaching staff, shared use of coping behaviors, and rational forms of cognitive appraisal (Lu et al., 2016). Contrastingly, negative social interactions such as insensitive behavior, neglect or intrusion are positively linked with burnout (Pacewicz et al., 2019), but relatedness frustration did not show any significant longitudinal associations with burnout in Model 5.

Study limitations

Key strengths of this study included the use of a longitudinal design, the testing of SDT, and recruitment of a diverse athletic sample. However, future studies could address the limitations of our study by utilising three or more measurement timepoints. Furthermore, the inclusion of linked self-reports from coaches and teammates alongside a larger athlete sample would provide additional information pertaining to the relative influence of needs-satisfying and frustrating sources (Ntoumanis et al., 2018). Lastly, as burnout and general mental health experiences may be more intense and have unique features in elite athletes (e.g., professional, international competitors) (Vella & Swann, 2021), further research may consider a focused sample approach for increased precision which may have additional study implications and practical recommendations.

Conclusion

The present study addressed gaps within SDT and broader literature of athlete burnout by adopting a longitudinal design, and testing several theoretical hypotheses related to darker and brighter athletic experiences (Bhavsar et al., 2019). Collectively, our study underscores the need for continuous tracking of athlete burnout levels throughout competitive seasons (Madigan et al., 2021), in addition to fostering needs-supportive climates for enhancing needs satisfaction (Ntoumanis et al., 2018) and protecting against athlete burnout (Bartholomew et al., 2009). With the widescale availability of valid athlete burnout measurement tools, the capturing of burnout levels is relatively quick, and practically feasible (Madigan et al., 2019). Tentatively, we suggest that if average levels are close to, or above the midpoint on the Likert scale format (e.g., ‘sometimes’ as reference), early on in a season, it may be prudent to implement multiple means to provide autonomy-support and minimise autonomy-control, such as providing opportunities for athlete input into team matters, and reinforcing the freedom for initiative taking, while minimising controlling language and behaviors (Ntoumanis et al., 2018). Given the protective effect that relatedness satisfaction exerted on

subsequent burnout levels in the present study, an environment characterized by reciprocal support and compassion is desired (Chen et al., 2018), as are regular opportunities to share coping behaviors (e.g., relaxation, cognitive appraisal) (Delrue et al., 2019). As athlete mental health promotion should be considered as fundamental to the sporting experience (Reardon et al., 2019), sporting organisations, policy makers and those involved in intervention design may consider the proposed evidence-based and theoretically derived techniques in areas of programme design. Future research may advance the present study by gathering athlete, coach and teammate data, whilst including additional timepoints.

Compliance with Ethical Standards

All authors agree that we have no conflict of interest to report.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the study.

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