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Original article

Longitudinal trajectories of athlete burnout among young table tennis players: A 3-wave study

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Abstract

Purpose: The purposes of this study were to examine the trajectories of athlete burnout across a 2-month period characterized by high physical, psychological, and social demands to explore (1) whether several subgroups of athletes representing distinct burnout trajectories emerged from the analyses and (2) whether athlete burnout symptoms (reduced accomplishment, sport devaluation, and exhaustion) developed in tandem or whether some burnout dimensions predicted downstream changes in other dimensions (causal ordering model).
Methods: One hundred and fifty-nine table tennis players in intensive training centers completed a self-reported athlete burnout measure across 3 time points within a 2-month period characterized by high demands. Data were analyzed through latent class growth analysis.
Results: Results of latent class growth analysis showed 3 distinct trajectories for each athlete burnout dimension, indicating not only linear or quadratic change but also stability in longitudinal athlete burnout perceptions. Results also suggested that the 3 dimensions of athlete burnout did not develop in tandem. Rather, the likelihood of belonging to particular emerging trajectories of sport devaluation and physical/emotional exhaustion was significantly influenced by the athletes' perception of reduced accomplishment assessed at Time 1. Thus, reduced accomplishment predicted downstream changes in the 2 other athlete burnout dimensions.
Conclusion: As a whole, these results highlighted that the multinomial heterogeneity in longitudinal athlete burnout symptoms needs to be accounted for in future research.

Keywords: Athlete burnout; Intensive training; Latent class growth analyses; Person-centered approach; Table tennis; Youth elite athletes

1. Introduction

Throughout their competitive season, young athletes in intensive training settings are confronted with a series of physical (e.g., training sessions), social (e.g., coach evaluation), and psychological (e.g., demonstrating personal competence) demands.[1] The demands associated with sport participation may lead some of these young athletes to experience burnout.[2] Growing empirical research has provided evidence that athlete burnout can be defined as a syndrome characterized by physical/emotional exhaustion, sport devaluation, and a reduced sense of accomplishment.[3] To date, most of the previous studies have examined athlete burnout using cross-sectional designs that are limited to understanding individual differences in athlete burnout changes.[4] The present study explored whether several subgroups of athlete burnout trajectories emerged over a period characterized by high physical, psychological, and social demands.

Longitudinal studies that have examined changes in athlete burnout have provided inconclusive results. Lonsdale and Hodge[5] showed nonsignificant differences in athlete burnout symptoms from early to later stages of a season among a sample of individual and team competitive athletes. In contrast, 2 other studies highlighted significant increases in athlete burnout across 12 weeks of a competitive season among professional New Zealand rugby union players[6] and from the onset to the end of school year among vocational dancers.[7] These mixed results could hide the presence of several kinds of subgroups (based on the athletes' changes in burnout dimensions themselves) given that the aforementioned studies used a variable-centered analytical approach that failed to look beyond

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mean level of athlete burnout scores. Specifically, mean-level analyses ignore potential variability and differences between individuals (i.e., differential instability). For instance, if half the athletes increase and half the athletes decrease in their perception of athlete burnout to the same extent, the opposite directions of change will yield a nonsignificant mean-level change. If two-thirds of the athletes increase and one-third of the athletes decrease in their perception of athlete burnout, mean-level analyses will yield a significant increase in athlete burnout, even though some athletes experience a decrease in athlete burnout. Hence, the normative stability examined in the athlete burnout literature[5–7] could be reported in the presence of differential instability, and *vice versa*.[8] These phenomena have been demonstrated in research examining the coping mechanisms of 107 soccer players.[9] The existence of distinctive subgroups of athletes with different longitudinal patterns of coping had canceled each other out, thus yielding nonsignificant mean-level effects despite meaningful change for a substantial number of athletes in the sample. To the best of our knowledge, this person-centered approach has not previously been applied to the investigation of the changes in athlete burnout over time. This methodological approach could help researchers and coaches to discern the existence of distinctive longitudinal patterns of athlete burnout. The person-centered perspective used in the present study may be especially useful in identifying higher risk profiles for athletes in need of targeted and adaptive intervention approaches to prevent the onset of athlete burnout (i.e., tailoring intervention efforts to the needs of specific groups of athletes).

Athlete burnout is conceptualized as an idiosyncratic process likely to change distinctively among athletes on the basis of personality dispositions and situational variables.[3,10] Therefore, it is quite unlikely that athletes' perception of burnout symptoms is characterized by a monotonic heterogeneity. For example, 2 young athletes in a period characterized by high social, psychological, and physical demands might not necessarily experience the same trajectory of athlete burnout during this period. One could experience an increase in burnout symptoms because of his or her difficulty in coping with everyday demands, whereas the other could experience a stable or decreasing trajectory of burnout symptoms owing to the use of adaptive coping strategies during the same period.[11] Thus, the first aim of the present study was to explore the trajectories of the 3 dimensions of athlete burnout during a period characterized by high physical, psychological, and social demands, because both the magnitude and the direction of change would be particularly likely to differ across individuals in such a demanding period. As such, we selected a 3-wave, 2-month research design, because this time frame represented a key point in the season for young athletes involved in intensive training centers for several reasons: (1) the athletes had been in the structure for 6−8 months (family separation); (2) it was the last school term (several exams, more homework); and (3) it was almost the end of the season (important matches with more pressure).[12]

Although conventional growth modeling approaches (e.g., random effects model) assume that a single growth trajectory can adequately approximate an entire population, there may exist a subset of individuals whose growth trajectories are significantly different from the overall estimate.[13] Latent class growth analysis (LCGA) offers a systematic framework for capturing information about interindividual differences in intraindividual change over time.[14] From this analysis emerge different subgroups of individuals who are likely to share the same longitudinal patterns of change or stability inside their respective latent classes.[13] Thus, although the multilevel modeling approach takes into account both intra- and interindividual variability in change, LCGA highlights different subgroups of individuals to further probe such variability.

In addition to finding out whether several kinds of subgroups and ongoing processes emerged from the longitudinal trajectories of athlete burnout symptoms, we also explored the relationships among the 3 athlete burnout dimensions. Especially, the second aim of the present study was to examine (1) whether athletes simultaneously belong to similar trajectories for different dimensions of athlete burnout and (2) whether some athlete burnout dimensions predict downstream changes in other dimensions over time. Previous studies provided evidence for a moderate level of correlation among the 3 athlete burnout dimensions, suggesting that they coexist within the person at any given point in time.[15,16] However, these findings have been obtained with the use of a variable-centered methodology that ignores potential variability and differences between individuals.[8] Therefore, it could be useful to examine whether athletes simultaneously belong to similar trajectories for distinct dimensions of athlete burnout.

Some athlete burnout dimensions might also predict downstream changes in other dimensions over time. In line with this approach, several causal ordering models have been proposed in the occupational literature.[17–20] The causal ordering approach hypothesizes a neatly defined unidirectional pathway of development in which some dimensions of burnout are well developed before the appearance of other dimensions of burnout.[17] Hence, several causal ordering models have been proposed in which exhaustion,[19] reduced accomplishment,[20] or depersonalization (an analogous factor to the sport devaluation dimension of the athlete burnout construct)[18] was the first stage of development. To test the causal ordering approach in the present study for the 3 athlete burnout dimensions, we examined independently whether the level of an athlete burnout dimension measured at Time 1 (T1) significantly predicted the probability of belonging to a particular trajectory of another athlete burnout dimension.

In sum, we analyzed the trajectories of the 3 dimensions (physical/emotional exhaustion, sport devaluation, and reduced accomplishment) of athlete burnout over 3 time points in a 2-month period characterized by high physical, psychological, and social demands to find out whether several kinds of subgroups and ongoing processes emerged from the LCGAs. In line with past longitudinal research conducted on the athlete burnout construct,[5–7] it was expected that up to 4 trajectories of athlete burnout would be uncovered: (1) a low-and-stable trajectory, (2) a low-and-increasing trajectory, (3) a moderate-and-stable trajectory, and (4) a moderate-and-increasing trajectory. We also explored the relationships between the 3 athlete burnout dimensions. We especially examined whether the 3

dimensions of the athlete burnout syndrome develop in tandem or whether some burnout dimensions predicted downstream changes in other dimensions (causal ordering model). Based on a substantial number of studies showing a moderate level of correlation among the 3 athlete burnout dimensions, it was expected that the 3 dimensions of the athlete burnout syndrome would develop in tandem.

2. Materials and methods

2.1. Participants

This study was part of a longitudinal research project involving young athletes in intensive training centers focused on different purposes. As a result, the sample of the present study was also used in previous studies. It is noteworthy that (1) the rationales, the aims of each study, and the results are fundamentally different and (2) none of the results pertaining to the data in this study are presented elsewhere. One hundred and fifty-nine youth table tennis players (50 girls and 109 boys aged 14.07 ± 2.13 years playing 6.36 ± 2.24 years, means $\pm$ SD) in intensive training centers participated in this study. Coaches indicated that their athletes trained 15.04 ± 5.78 h/week. A 3-wave 2-month design (1 month between each completion) was used in the present study. In particular, athlete burnout data were available at T1 for 156 participants, at Time 2 (T2) for 152 participants, and at Time 3 (T3) for 146 participants (141 participants completed the measures over all time points). Injury and the existence of international training camps or competitions were the main reasons for missing data.

2.2. Measures

The French version[15] of the athlete burnout questionnaire[16] contains three 4-item subscales measuring physical/emotional exhaustion, sport devaluation, and reduced sense of accomplishment as well as a total score of athlete burnout computed as the sum of the 3 athlete burnout dimensions. Previous research lent credence to the validity and reliability of the athlete burnout questionnaire scores.[15,16] Participants responded on a 5-point Likert scale with values ranging from 1 (*almost never*) to 5 (*most of the time*). Hence, scores ranged from 4 to 20 and 12 to 60 for the 3 subscales and the total score, respectively. Cronbach's α ranged from 0.69 to 0.91 (Table 1).

2.3. Procedures

The research was conducted in accordance with international ethical guidelines and was approved by the National Table Tennis Federation's Ethical Committee. Head coaches from all the intensive training centers accredited by the National Table Tennis Federation were contacted to obtain permission to approach their athletes for participation in the study. Intensive training centers are structures that receive the best young athletes in the country. A national decree (decree of July 18, 2002) specified that these training centers should focus on helping athletes to reach the highest levels of performance, providing the necessary preparation for a successful transition to professional sporting life, and having good academic results.[11] Fifteen coaches (of the 16 contacted) gave their approval to approach their athletes for participation. One member of the research team was present for each completion. The questionnaires were administered before a training session in groups of 5−15 participants. As part of this process, the member of the research team emphasized the nature of the questionnaire process and the handling of quantitative data (e.g., purpose of the study, researcher's intended use of the data). At no point in this process were participants informed that the study was examining athlete burnout. All participants were also assured that their responses would be kept completely confidential and that they could withdraw without consequence.[21] The athletes' participation was voluntary, and written informed consent was obtained from each individual (and also from their parents) before data collection. Data collection occurred at 3 time points (1 month between each completion) during a 2-month (March−May) demanding period. Results of data related to perceived stress, perceived recovery, and sport motivation have been presented in published articles.[1,2,11,12]

2.4. Data analysis

The statistical analyses were carried out on Mplus Version 7.3 (Muthén & Muthén, Los Angeles, CA, USA)[22] using the full information maximum likelihood estimation of missing data. This is an unbiased and more efficient method under the missing at random assumption compared with, for example, listwise deletion, which yields biased parameters.[23,24] The data set was screened for multivariate outliers; no outlier was identified. Then an LCGA was performed.[13] LCGA is a multivariate statistical model that posits that an underlying grouping variable (a latent class variable) is not observed but can be inferred from a set of indicators to discover distinct trajectories on a psychological variable with different patterns of change and stability.[9] Although to the best of our knowledge there is no rule of thumb for LCGA estimations concerning the required sample size, previous studies in the sports literature

Table 1
Mean (M), standard deviation (SD), and Cronbach's α for the athlete burnout dimensions across the 3 waves.

Dimension	Time 1			Time 2			Time 3		
	M	SD	α	M	SD	α	M	SD	α
Reduced accomplishment	2.45	0.72	0.69	2.35	0.72	0.69	2.40	0.76	0.75
Sport devaluation	1.80	0.89	0.81	1.76	0.86	0.83	1.84	0.90	0.85
Emotional/physical exhaustion	3.09	0.88	0.89	2.99	0.95	0.91	2.87	0.92	0.91
Total score of athlete burnout	2.45	0.55	0.76	2.37	0.57	0.79	2.37	0.60	0.82

used a sample of 107 male soccer players along 3 measurement occasions.[8] As such, the sample size of the present study is likely to be acceptable to compute LCGA models.

First, the analysis involved the careful selection of a model that accurately captured the number and the shape of the trajectories describing each of the athlete burnout symptoms. Four sets of analyses were performed, 1 for each athlete burnout dimension and 1 for the total score of athlete burnout. Following the recommendation of Jung and Wickrama,[13] a series of models with increasing numbers of trajectories were progressively tested to determine which model provided the best fit (i.e., until there was no further improvement of the model). With LCGA models, there is not a single statistical indicator of good model fit. As a result, a combination of statistical indicators was used to decide on the best-fitting model: log likelihood value, Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted BIC (ABIC), and Lo, Mendell, and Rubin likelihood ratio test (LRT). The smallest values on the AIC, BIC, and ABIC as well as the highest values on the log likelihood value indicated the best-fitting model.[1,25] Additionally, the LRT was used for model comparison (e.g., χ^2 difference test between 1- and 2-class models). It is noteworthy that initial LCGA models included the initial mean level (intercept) and the linear and quadratic growths (increase or decrease) for each trajectory. Then the best-fitting LCGA models with both linear and quadratic functions for each trajectory were compared with their respective LCGA models with only the linear function for each trajectory. Specifically, the LRT allowed highlighting of an eventual significant improvement of fit if fewer parameters were included in the model (i.e., omitting quadratic functions from LCGA models).[1]

Second, we explored whether the 3 dimensions of the athlete burnout syndrome develop in tandem. Thus, we conducted 3 χ^2 tests of association between the athlete burnout dimensions to explore whether the same athletes belonged to the same trajectories across the 3 dimensions of athlete burnout.

Third, we examined whether some burnout dimensions predicted downstream changes in other dimensions (causal ordering model). Specifically, a series of LCGA models was computed in which each of the athlete burnout dimensions assessed at T1 were independently incorporated as a covariate of the latent classes (i.e., trajectories) of another athlete burnout dimension. This allowed us to examine whether a particular burnout dimension measured at T1 significantly predicted the probability of belonging to a particular trajectory on another burnout dimension. It is noteworthy that for each of the 3 athlete burnout dimensions, the trajectories with the highest intercept were set as the constant group because these trajectories might be conceptualized as being maladaptive.

3. Results

3.1. Preliminary analyses

The descriptive statistics across the 3 waves are presented in Table 1. Results of a multiple analysis of variance test indicated that athlete burnout scores as a whole did not change across the 3 waves (Wilks's $\lambda = 0.99$, $F(6, 898) = 1.02$, $p = 0.41$, $\eta^2 = 0.01$). Univariate analysis of variance tests indicated that reduced accomplishment ($F(2, 451) = 0.62$, $p = 0.54$, $\eta^2 = 0.00$), sport devaluation ($F(2, 451) = 0.28$, $p = 0.76$, $\eta^2 = 0.00$), exhaustion ($F(2, 451) = 2.16$, $p = 0.12$, $\eta^2 = 0.01$), or total score of athlete burnout ($F(2, 451) = 0.93$, $p = 0.39$, $\eta^2 = 0.00$) did not change significantly across waves.

3.2. LCGAs

Examining the results of the LCGA models in Table 2, the AIC, BIC, ABIC, and LRT indicated that the 3-class models fit best. Specifically, there were big drops between 1 and 2 classes and between 2 and 3 classes for the AIC, BIC, and ABIC. Similarly, the LRT provided evidence that 2 classes fit better than 1 class and that 3 classes fit better than 2, whereas 4 or 5 classes do not fit better. As a consequence, a 3-class solution was selected for reduced accomplishment, sport devaluation, physical/emotional exhaustion, and the total score of athlete burnout. For both reduced accomplishment and physical/emotional exhaustion, the LRTs (LRTs = 12.84 and 7.21, respectively, $\Delta df = 3$, $p = 0.005$ and 0.06) indicated significant worsening of fit if quadratic functions were omitted (i.e., evidence for quadratic parameters). For sport devaluation and total score athlete burnout, the LRTs (LRTs = 3.73 and 5.77, respectively, $\Delta df = 3$, $p > 0.10$) indicated nonsignificant worsening of fit if quadratic functions were omitted. However, given that a quadratic function was significant for one of the sport devaluation and athlete burnout trajectories (Table 3), and to be consistent among the 3 dimensions of athlete burnout, the linear and quadratic parameters of sport devaluation and total score of athlete burnout were retained.[13]

The estimates of the emerging trajectories for the LCGA models of each of the 3 dimensions of athlete burnout are presented in Table 3. For reduced accomplishment, the low-and-unstable subgroup (34.0%, $n = 54$) was composed of athletes who experienced low level of reduced accomplishment, with a significant positive quadratic function of decline from the first to the second wave, followed by an increase afterward (intercept = 7.55, $p < 0.001$; linear = −1.67, $p < 0.001$; quadratic = 0.70, $p = 0.001$). The moderate-and-stable subgroup (50.9%, $n = 81$) represented athletes who experienced a moderate level of reduced accomplishment across the 3 waves (intercept = 10.01, $p < 0.001$; linear = 0.49, $p = 0.39$; quadratic = −0.21, $p = 0.42$). The high-and-unstable subgroup (15.1%, $n = 24$) was composed of athletes who experienced a high level of reduced accomplishment, with a marginal positive quadratic function (intercept = 14.35, $p < 0.001$; linear = −1.78, $p = 0.02$; quadratic = 0.80, $p = 0.09$). For sport devaluation, the low-and-unstable subgroup (59.8%, $n = 95$) was composed of athletes who experienced a low level of sport devaluation, with a significant positive quadratic function (intercept = 5.21, $p < 0.001$; linear = −0.73, $p = 0.08$; quadratic = 0.42, $p = 0.04$); the moderate-and-stable subgroup (31.4%, $n = 50$) and the high-and-stable subgroup (8.8%, $n = 14$) represented athletes who experienced moderate (intercept = 8.87, $p < 0.001$; linear = 0.32, $p = 0.75$; quadratic = −0.14, $p = 0.77$) and high

Table 2
Fit indices of LCGA models with 1−5 classes for the athlete burnout dimensions.

	Class 1	Class 2	Class 3	Class 4	Class 5
Free parameter (*n*)	6	10	14	18	22
Reduced accomplishment					
Log likelihood	−1131.34	−1069.76	**−1036.06**	−1028.08	−1023.38
AIC	2274.68	2159.53	**2100.12**	2092.17	2090.76
BIC	2293.10	2190.22	**2143.08**	2147.41	2158.28
ABIC	2274.10	2158.56	**2098.76**	2090.43	2088.63
LRT	NA	123.16*	**67.41***	15.95	9.41
Sport devaluation					
Log likelihood	−1213.48	−1104.63	**−1049.37**	−1033.89	−1016.21
AIC	2438.96	2229.25	**2126.74**	2103.78	2076.42
BIC	2457.38	2259.94	**2169.71**	2159.02	2143.93
ABIC	2438.38	2228.29	**2125.39**	2102.04	2074.29
LRT	NA	217.71*	**110.51***	30.96	35.36
Physical/emotional exhaustion					
Log likelihood	−1232.90	−1147.79	**−1126.40**	−1120.55	−1112.41
AIC	2477.80	2315.58	**2280.80**	2277.11	2268.82
BIC	2496.21	2346.27	**2323.76**	2332.35	2336.33
ABIC	2477.22	2314.61	**2279.44**	2275.37	2266.29
LRT	NA	170.22*	**42.78***	11.69	16.29
Total score of athlete burnout					
Log likelihood	−1516.66	−1458.12	**−1422.32**	−1409.89	−1400.28
AIC	3045.32	2936.24	**2872.64**	2855.78	2844.56
BIC	3063.73	2966.93	**2915.60**	2911.02	2912.08
ABIC	3044.74	2935.27	**2871.29**	2854.04	2842.43
LRT	NA	117.08	**71.60***	24.86*	19.22

Note: Bold entries reflect selected model.
* $p < 0.05$, significant difference between the model with *n* class and the model with $n - 1$ class.
Abbreviations: ABIC = adjusted BIC; AIC = Akaike information criterion; BIC = Bayesian information criterion; LCGA = latent class growth analysis; LRT = Lo, Mendell, and Rubin likelihood ratio test; NA = not available.

levels (intercept = 14.92, $p < 0.001$; linear = 0.82, $p = 0.26$; quadratic = −0.51, $p = 0.16$) of sport devaluation across the 3 waves, respectively. For physical/emotional exhaustion, the low-and-decreasing subgroup (23.9%, $n = 38$) representedathletes who experienced a low level of exhaustion while exhibiting a marginal negative linear function (intercept = 8.70, $p < 0.001$; linear = −1.69, $p = 0.09$; quadratic = 0.45, $p = 0.35$); the moderate-and-unstable subgroup (37.7%, $n = 60$) was composed of athletes who experienced moderate level of exhaustion, with a significant positive quadratic function (intercept = 11.94, $p < 0.001$; linear = −1.54, $p = 0.01$; quadratic = 0.61, $p = 0.04$); and the high-and-unstable subgroup (38.4%, $n = 61$) was composed of athletes who experienced high level of exhaustion, with a significant negative quadratic function (intercept = 15.25, $p < 0.001$; linear = 0.98, $p = 0.14$; quadratic = −0.59, $p = 0.05$). Finally, for the total score of

Table 3
Longitudinal trajectories of athlete burnout dimensions across the 3 waves.

	n	Intercept			Linear			Quadratic		
		Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*
Reduced accomplishment										
Low-and-unstable	54	7.55	0.33	<0.001	−1.67	0.41	<0.001	0.70	0.22	0.001
Moderate-and-stable	81	10.01	0.46	<0.001	0.49	0.57	0.39	−0.21	0.27	0.42
High-and-unstable	24	14.35	0.65	<0.001	−1.78	0.76	0.02	0.80	0.47	0.09
Sport devaluation										
Low-and-unstable	95	5.21	0.23	<0.001	−0.73	0.42	0.08	0.42	0.20	0.04
Moderate-and-stable	50	8.87	0.47	<0.001	0.32	0.99	0.75	−0.14	0.49	0.77
High-and-stable	14	14.92	0.77	<0.001	0.82	0.73	0.26	−0.51	0.36	0.16
Physical/emotional exhaustion										
Low-and-decreasing	38	8.70	0.53	<0.001	−1.69	1.01	0.09	0.45	0.48	0.35
Moderate-and-unstable	60	11.94	0.49	<0.001	−1.54	0.61	0.01	0.61	0.30	0.04
High-and-unstable	61	15.25	0.37	<0.001	0.98	0.67	0.14	−0.59	0.31	0.05
Total score of athlete burnout										
Low, decreasing-and-unstable	57	24.85	0.92	<0.001	−4.16	1.28	0.001	1.35	0.55	0.01
Moderate-and-stable	85	30.10	0.65	<0.001	0.33	1.05	0.75	0.01	0.52	0.99
High-and-stable	17	41.00	2.03	<0.001	−1.86	2.08	0.37	0.64	1.00	0.52

Abbreviation: SE = standard error.

athlete burnout, the low, decreasing-and-unstable subgroup (35.8%, $n = 57$) was composed of athletes who experienced a low level of athlete burnout while exhibiting a significant linear decrease and a significant quadratic function (intercept = 24.85, $p < 0.001$; linear = −4.16, $p = 0.001$; quadratic = 1.35, $p = 0.01$); the moderate-and-stable subgroup (53.5%, $n = 85$) and the high-and-stable subgroup (10.7%, $n = 17$) represented athletes who experienced moderate (intercept = 30.10, $p < 0.001$; linear = 0.33, $p = 0.75$; quadratic = 0.01, $p = 0.99$) and high (intercept = 41.00, $p < 0.001$; linear = −1.86, $p = 0.37$; quadratic = 0.64, $p = 0.52$) levels of athlete burnout across the 3 waves, respectively.

3.3. Relationships between the emerging trajectories of the athlete burnout dimensions

Result of a χ^2 test of 3 sport devaluation latent classes and 3 reduced accomplishment latent classes indicated that the distribution of the athletes differed significantly across the emerging trajectories of reduced accomplishment and sport devaluation ($\chi^2(4) = 36.61$, $p < 0.001$). Nevertheless, Table 4 does not provide evidence that reduced accomplishment and sport devaluation develop in tandem. For instance, although 81.48% of athletes from the low-and-unstable trajectory of reduced accomplishment belonged to the low-and-unstable trajectory of sport devaluation, 56.79% of athletes from the moderate-and-unstable trajectory of reduced accomplishment also belonged to the low-and-unstable trajectory of sport devaluation. Concerning the high-and-unstable trajectory of reduced accomplishment, 20.83%, 45.84%, and 33.33% of athletes from this trajectory belonged to the low-and-unstable, moderate-and-stable, and high-and-stable trajectories of sport devaluation, respectively. Results of χ^2 tests of 3 sport devaluation latent classes and 3 physical/emotional exhaustion latent classes and of 3 reduced accomplishment latent classes and 3 physical/emotional exhaustion latent classes indicated that the distribution of the athletes did not differ across the emerging trajectories of these athlete burnout dimensions ($\chi^2(4) = 0.61$ and 2.50, respectively; $p > 0.10$), suggesting that the same athletes did not belong to the same trajectories across these athlete burnout dimensions. As a whole, these results provided evidence that the 3 dimensions of athlete burnout did not develop in tandem.

Results of the additional LCGA models showed that the likelihood of belonging to an emerging trajectory of reduced accomplishment or sport devaluation was not significantly influenced by the physical/emotional exhaustion experienced by athletes at T1 (Table 5). However, the likelihood of belonging to the moderate-and-unstable trajectory of reduced accomplishment—relative to the high-and-unstable trajectory of reduced accomplishment—was negatively related to the sport devaluation experienced by athletes at T1 ($p = 0.02$). The likelihoods of belonging to the low-and-unstable and

Table 4
Changes in the distribution of athletes across the emerging trajectories of the athlete burnout dimensions.

Reduced accomplishment	Sport devaluation	*n* (%)	Reduced accomplishment	Physical/ emotional exhaustion	*n* (%)	Sport devaluation	Physical/ emotional exhaustion	*n* (%)
Low-and-unstable ($n = 54$)	Low-and-unstable ($n = 95$)	44 (81.48, 46.32)[a]	Low-and-unstable ($n = 54$)	Low-and-decreasing ($n = 38$)	12 (22.22, 31.58)	Low-and-unstable ($n = 95$)	Low-and-decreasing ($n = 38$)	23 (24.21, 60.53)
	Moderate-and-stable ($n = 50$)	9 (16.67, 18.00)		Moderate-and-unstable ($n = 60$)	23 (42.59, 38.33)		Moderate-and-unstable ($n = 60$)	37 (38.95, 61.67)
	High-and-stable ($n = 14$)	1 (1.85, 7.14)		High-and-unstable ($n = 61$)	19 (35.19, 31.15)		High-and-unstable ($n = 61$)	35 (36.84, 57.38)
Moderate-and-unstable ($n = 81$)	Low-and-unstable ($n = 95$)	46 (56.79, 48.42)	Moderate-and-unstable ($n = 81$)	Low-and-decreasing ($n = 38$)	20 (24.69, 52.63)	Moderate-and-stable ($n = 50$)	Low-and-decreasing ($n = 38$)	12 (24.00, 31.58)
	Moderate-and-stable ($n = 50$)	30 (37.04, 60.00)		Moderate-and-unstable ($n = 60$)	31 (38.27, 51.67)		Moderate-and-unstable ($n = 60$)	17 (34.00, 28.33)
	High-and-stable ($n = 14$)	5 (6.17, 35.71)		High-and-unstable ($n = 61$)	30 (37.04, 49.18)		High-and-unstable ($n = 61$)	21 (42.00, 34.43)
High-and-unstable ($n = 24$)	Low-and-unstable ($n = 95$)	5 (20.83, 5.26)	High-and-unstable ($n = 24$)	Low-and-decreasing ($n = 38$)	6 (25.00, 15.79)	High-and-stable ($n = 14$)	Low-and-decreasing ($n = 38$)	3 (21.43, 7.89)
	Moderate-and-stable ($n = 50$)	11 (45.84, 22.00)		Moderate-and-unstable ($n = 60$)	6 (25.00, 10.00)		Moderate-and-unstable ($n = 60$)	6 (42.86, 10.00)
	High-and-stable ($n = 14$)	8 (33.33, 57.14)		High-and-unstable ($n = 61$)	12 (50.00, 19.67)		High-and-unstable ($n = 61$)	5 (35.71, 8.20)

[a] Of the 54 athletes composing the low-and-unstable trajectory of reduced accomplishment, 44 (or 81.48%) belonged to the low-and-unstable trajectory of sport devaluation. These 44 athletes represented 46.32% of the-low-and unstable trajectory of sport devaluation.

Table 5
Association of time 1 (T1) athlete burnout scores with trajectories of reduced accomplishment, sport devaluation, and physical/emotional exhaustion.

Model	Estimate	Odds ratio	*p*
Reduced accomplishment			
Trajectory 1: low-and-unstable			
T1 sport devaluation	−0.15	0.86	0.28
T1 physical/emotional exhaustion	0.23	1.26	0.16
Trajectory 2: moderate-and-unstable			
T1 sport devaluation	−0.18	0.84	0.02
T1 physical/emotional exhaustion	0.16	1.17	0.34
Trajectory 3: high-and-unstable (constant)			
Sport devaluation			
Trajectory 1: low-and-unstable			
T1 reduced accomplishment	−0.49	0.61	0.002
T1 physical/emotional exhaustion	0.01	1.01	0.97
Trajectory 2: moderate-and-stable			
T1 reduced accomplishment	−0.32	0.73	0.02
T1 physical/emotional exhaustion	−0.01	0.99	0.97
Trajectory 3: high-and-stable (constant)			
Physical/emotional exhaustion			
Trajectory 1: low-and-decreasing			
T1 reduced accomplishment	0.39	1.48	0.004
T1 sport devaluation	−0.08	0.92	0.38
Trajectory 2: moderate-and-unstable			
T1 reduced accomplishment	0.52	1.68	<0.001
T1 sport devaluation	−0.20	0.82	0.03
Trajectory 3: high-and-unstable (constant)			

moderate-and-stable trajectories of sport devaluation—relative to thehigh-and-stable trajectory of sport devaluation—were negatively related to the reduced accomplishment experienced by athletes at T1 ($p = 0.002$, $p = 0.02$, respectively). It can be concluded that athletes who experienced high-and-stable sport devaluation are more likely to experience higher scores of reduced accomplishment at T1 than athletes characterized by the 2 other trajectories of sport devaluation. In contrast, the likelihoods of belonging to the low-and-decreasing and moderate-and-unstable trajectories of physical/emotional exhaustion—relative to the high-and-unstable trajectory of physical/emotional exhaustion—were positively related to the reduced accomplishment experienced by athletes at T1 ($p = 0.004$, $p < 0.001$, respectively). It can be concluded that athletes who experienced high-and-unstable physical/emotional exhaustion are less likely to experience higher scores of reduced accomplishment at T1 than athletes characterized by the 2 other trajectories of physical/emotional exhaustion.

4. Discussion

This study examined athlete burnout perceptions of young table tennis players in intensive training centers across 3 time points held over a 2-month period characterized by high physical, psychological, and social demands. Although the nonsignificant mean-level effects observed on the 3 dimensions of athlete burnout suggested that on average, athlete burnout symptoms did not change over time, the use of a person-centered approach accounting for multinomial heterogeneity revealed the existence of distinctive subgroups of athletes with different longitudinal patterns of athlete burnout. Specifically, results of LCGA highlighted the existence of 3 distinct longitudinal trajectories for each of the 3 athlete burnout dimensions and for the total score of athlete burnout. Some athletes maintained the same level of burnout symptoms over time (i.e., athletes from the moderate-and-stable trajectory of reduced accomplishment, and moderate-and-stable and high-and-stable trajectories of sport devaluation and athlete burnout total score), whereas other athletes experienced a linear decrease of burnout symptom over time (i.e., low-and-decreasing trajectory of exhaustion and low, decreasing, and unstable trajectory of athlete burnout total score). Some athletes experienced an increase of burnout symptoms after the first wave followed by a decrease after the second wave (i.e., high-and-unstable trajectory of exhaustion), whereas other experienced the opposite pattern of results (i.e., low-and-unstable and high-and-unstable trajectories of reduced accomplishment, low-and-unstable trajectory of sport devaluation, moderate-and-unstable trajectory of exhaustion, and low, decreasing, and unstable trajectory of athlete burnout total score).

From a theoretical viewpoint, these results indicated that some athletes remain stable in their perceptions of burnout symptoms and other athletes change their perceptions across the 3 waves of the research. Furthermore, the “changers” were characterized by different magnitude and direction of change. In some respects, the fact that no significant positive linear slope has emerged from LCGAs is surprising. This means that no athlete experienced a progressive increase in athlete burnout over time while data collection was carried out during a 2-month period characterized by high physical, psychological, and social demands. This result could be explained by the timing of data collection. Specifically, because data collection occurred near the end of the season, athlete burnout scores might have already attained their highest levels, leading to a stabilization (rather than a progressive increase) of the athlete burnout scores over time. It is also noteworthy that because athlete burnout is considered to be an enduring phenomenon, substantial time seems to be needed to note changes.[3] Nevertheless, it is not clear how long this period needs to be.[12] Therefore, the 1-month interval between each measurement used in the present study could have prevented us from observing a progressive increase in burnout symptoms over time.

A central aspect of the present research that has been overlooked in the literature on athlete burnout was the documentation of the relationship between the 3 athlete burnout dimensions over time.[4,10] Specifically, we explored whether the 3 dimensions of the athlete burnout syndrome develop in tandem or whether some burnout dimensions predict downstream changes in other dimensions (causal ordering model). There was only 1 significant result in favor of the former hypothesis. Specifically, 81.48% of athletes from the low-and-unstable trajectory of reduced accomplishment also belonged to the low-and-unstable trajectory of sport devaluation. However, 56.79% of athletes from the moderate-and-unstable trajectory of reduced accomplishment also belonged to the low-and-unstable trajectory of sport devaluation. Thus, as a whole, results suggested that the 3 dimensions of athlete burnout do

not develop in tandem. In some respects, these results are rather surprising given that a substantial number of studies highlighted moderate level of correlations between the 3 athlete burnout dimensions, suggesting that they coexist within the person at any given point in time.[15,16] Nevertheless, it is worth noting that to the best of our knowledge, the investigations examining the relationships between the 3 athlete burnout dimensions have relied exclusively on cross-sectional designs within the sport literature. If the methodological design could partly explain the divergent results observed between longitudinal and cross-sectional studies, future research should explore the mechanisms that could explain the distinct results observed in longitudinal versus cross-sectional research.

Results provided preliminary evidence for the existence of a causal ordering model (i.e., some athlete burnout dimensions predicted downstream changes in other dimensions). LCGA results suggested that reduced accomplishment predicted changes in the 2 other athlete burnout dimensions. Specifically, the likelihoods of belonging to particular emerging trajectories of sport devaluation and physical/emotional exhaustion were significantly influenced by the athletes' perception of reduced accomplishment assessed at T1. For instance, the likelihoods of belonging to the low-and-unstable and moderate-and-stable trajectories of sport devaluation—relative to the high-and-stable trajectory of sport devaluation—were negatively related to the reduced accomplishment experienced by athletes at T1. These results were consistent with the causal ordering model proposed by Van Dierendonck et al.[20] within the occupational literature. In contrast, the likelihoods of belonging to the low-and-decreasing and moderate-and-unstable trajectories of physical/emotional exhaustion—relative to the high-and-unstable trajectory of physical/emotional exhaustion—were positively related to the reduced accomplishment experienced by athletes at T1. These results were rather surprising because it could be expected that athletes who experienced high-and-unstable physical/emotional exhaustion were more (and not less) likely to experience higher scores of reduced accomplishment at T1 than athletes characterized by the 2 other trajectories of physical/emotional exhaustion. It is possible that athletes who experienced a high level of reduced accomplishment at T1 were less likely to commit to their maximum during subsequent training sessions (T2 and T3), leading them to be characterized by the low-and-decreasing trajectory of physical/emotional exhaustion. However, given that this explanation is purely speculative, future research should test this relationship again to see whether it emerges in other samples or whether it was a result specific to the current sample.

As is always the case with studies grounded in a person-centered approach, the emerging trajectories are data driven and sample specific. This research was performed with a sample of 159 young table tennis players in intensive training centers surveyed across 3 waves held over a 2-month period characterized by high physical, psychological, and social demands. Hence, adding measurement points with different time intervals or rerunning the analyses on a different sample could produce slightly different longitudinal trajectories of athlete burnout. Therefore, research is clearly needed to examine athlete burnout throughout a season with diversified samples from individual and team sports, young and older athletes, or nonprofessional and professional athletes. Further research could also explore whether covariates such as personality, cognitive appraisals, or significant others (e.g., parents, coaches, or other athletes) are likely to influence athlete burnout experienced by young athletes in intensive training centers.[10] For instance, recent studies suggested that perfectionism could be included as a covariate of athlete burnout in the design of future research.[26] Thus, future research should test, using an LCGA approach, whether the levels of personality (e.g., perfectionism, mental toughness) and/or cognitive appraisals (e.g., threat, challenge) measured at the start of the season significantly predicted the probability of belonging to a particular trajectory of athlete burnout computed over the course of the season.

5. Conclusion

Despite its limitations, this study was the first to provide a detailed portrait of multiple patterns of change and stability in athlete burnout symptoms. The analytical approach used in this study was useful in describing multinomial patterns of longitudinal change and stability of athlete burnout. Moreover, LCGA suggested that reduced accomplishment predicted downstream changes in sport devaluation and physical/emotional exhaustion. As a whole, results of the present study highlighted that the multinomial heterogeneity in longitudinal athlete burnout symptoms needs to be accounted for in future research.

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Authors' contributions

GM conceived of, designed, and carried out the studies and the data collections, performed statistical analyses, and drafted the manuscript; BL participated in the statistical analysis design and writing of the manuscript; JCD collected data and participated in the writing of the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

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