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Guillaume Martinent, Benoit Louvet, Jean-Claude Decret. Longitudinal trajectories of athlete burnout among young table tennis players: A 3-wave study. *Journal of Sport and Health Science*, 2016, 10.1016/j.jshs.2016.09.003 . hal-02367768

HAL Id: hal-02367768

<https://hal.science/hal-02367768>

Submitted on 22 Aug 2022

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Original article

Longitudinal trajectories of athlete burnout among young table-tennis players:

A 3-wave study

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Running head: Trajectories of athlete burnout

Received 28 March 2016; revised 28 June 2016; accepted 20 September 2016

Abstract

Purpose: the purposes were to examine the trajectories of athlete burnout across a 2-month period characterized by high physical, psychological, and social demands in order to explore: (a) if several subgroups of athletes representing distinct burnout trajectories emerged from the analyses; and (b) whether athlete burnout symptoms (reduced accomplishment, sport devaluation, and exhaustion) developed in tandem or if 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 analysed through Latent Class Growth Analyses (LCGAs).

Results: Results of LCGAs showed 3 distinct trajectories for each athlete burnout dimension, not only indicating 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 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 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 researches.

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 understand individual differences in athlete burnout changes.⁴ The present study explored if several kinds of subgroups emerged regarding the athlete burnout trajectories 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 Hodge⁵ showed non-significant 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 players⁶ 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 of burnout dimensions themselves) given that the aforementioned studies only used of a variable-centered analytical approach that failed to look beyond 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 of the athletes, respectively, increase and 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 athlete decrease in their perception of athlete burnout, mean-level analyses will yield a significant increase in athlete burnout whereas some athletes experience a decrease in athlete burnout. Hence, normative stability examined in the athlete burnout literature⁵⁻⁷ could be reported in presence of differential instability, and vice versa.⁸ These phenomena have been demonstrated in a research examining the coping utilization of 107 soccer players.⁹ The existence of distinctive subgroups of athletes with different longitudinal patterns of coping utilization had cancelled each other out, thus yielding non-significant 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 revealing the existence of distinctive longitudinal patterns of athlete burnout. Especially, the person-centered perspective used in the present study may be useful in identifying higher risk profiles for athletes in need of targeted and adaptive intervention approaches in order 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 across athletes on the basis of varying personality dispositions and situational variables.^{3,10} Therefore, it is quite unlikely that athletes' perception of burnout symptoms was characterized by a monotonic heterogeneity. For example, 2 young athletes embedded 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 of athlete burnout symptoms because of his difficulty to cope with everyday demands whereas the other could experience a stable or decreasing trajectory of burnout symptoms due to the use of adaptive coping strategies during the same period.¹¹ Thus, the first aim of the present study was to explore trajectories of the 3 dimensions of athlete burnout during a period

characterized by high physical, psychological, and social demands because both the magnitude and direction of change in athlete burnout 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 of time in the season for young athletes involved in intensive training centers: (a) the athletes had been in the structure for 6—8 months (family separation); (b) it was the last school term (several exams, more homework); and (c) 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 to capture information about inter-individual differences in intra-individual 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 multilevel modeling approach takes into account both intra- and inter-individual variability in change, LCGA highlights different subgroups of individuals to further probe such variability.

In addition to find out if several kinds of subgroups and on-going processes emerged from the longitudinal trajectories of athlete burnout symptoms we also explored the relationships between the 3 athlete burnout dimensions. Especially, the second aim of the present study was to examine: (a) whether athletes simultaneously belong to similar trajectories for different dimensions of athlete burnout; and (b) if some athlete burnout dimensions predict downstream changes in other dimensions over time. Previous studies provided evidence for moderate level of correlations between the 3 athlete burnout dimensions, suggesting that they co-exist 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 if 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 within the occupational literature.¹⁷⁻²⁰ The causal ordering approach hypothesized 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 either exhaustion,¹⁹ reduced accomplishment²⁰ or depersonalization (an analogous factor to the sport devaluation dimension of the athlete burnout construct)¹⁸ were the first stage of developing. To test the causal ordering approach in the present study, we examined independently for the 3 athlete burnout dimensions 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 analysed 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 in order to find out if several kinds of subgroups and on-going processes emerged from the LCGAs. In line with past longitudinal research conducted on the athlete burnout construct⁵⁻⁷, it was expected that up to 4 trajectories of athlete burnout would be uncovered: (a) a low-and-stable trajectory; (b) a low-and-increasing trajectory; (c) a moderate-and-stable trajectory; and (d) a moderate-and-increasing trajectory. We also explored the relationships between the 3 athlete burnout dimensions. Especially, we examined if the 3 dimensions of the athlete burnout syndrome develop in tandem or if some burnout dimensions predicted downstream changes in

other dimensions (causal ordering model). Based on a substantial number of studies showing moderate level of correlations between 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 on 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: (a) the rationales, the aims of each study and the results are fundamentally different, and (b) 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 exercise 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. Athlete burnout data were available in Time 1 (T1) for 156 participants, in Time 2 (T2) for 152 participants, and in Time 3 (T3) for 146 participants (141 participants completed the measures over all time points). Injury and international training camps or competitions were the main reasons for missing data.

2.2. Measures

The French version¹⁵ of the Athlete Burnout Questionnaire (ABQ)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 ABQ 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. Especially, a national decree (Decree of July 18th 2002) specified that these training centers 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 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 they could withdraw without consequence.²¹ The athletes' participation was voluntary, written informed consent was obtained from each individual prior to data collection (and also from their parents). 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 (Los Angeles, CA, USA)²² using the full information maximum likelihood (FIML) estimation of missing data.

FIML 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 which posits that an underlying grouping variable (a latent class variable) is not observed but can be inferred from a set of indicators in order 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 study conducting within the sport literature 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.

Firstly, 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 set of analyses were performed, one for each athlete burnout dimension and one for the total score of athlete burnout. Following the recommendation of Jung and Wickrama,¹³ a series of models with increasing number of trajectories were progressively tested in order 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 were 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 model that yielded 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 the

linear and quadratic functions for each trajectory were compared to their respective LCGA models with only the linear function for each trajectory. Specifically, the LRT allowed highlighting an eventual significant improvement of fit if fewer parameters are included in the model (i.e., omitting quadratic functions from LCGA models).¹

Secondly, we explored if 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 in order to explore whether the same athletes belonged to the same trajectories across the 3 dimensions of athlete burnout.

Thirdly, we examined if some burnout dimensions predicted downstream changes in other dimensions (causal ordering model). Specifically, a series of LCGA models were 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 if 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 maladaptive.

3. Results

3.1. Preliminary analyses

The descriptive statistics across the 3 waves are presented in Table 1. Results of a MANOVA indicated that athlete burnout scores as a whole did not change across the 3 waves, Wilks' Lambda = 0.99, $F(6, 898) = 1.02$, $p = 0.41$, $\eta^2 = 0.01$. Univariate ANOVAs 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 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, $\Delta df = 3, p > 0.10$) indicated non-significant 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 trajectory (Table 3) and in order to be consistent between 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 (33.96%, $n = 54$) was comprised 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 (50.94%, $n = 81$) 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, $p = 0.42$); and the high-and-unstable subgroup (15.09%, $n = 24$) was comprised of athletes who experienced 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 (59.75%, $n = 95$) was comprised of athletes who experienced 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 (31.45%, $n = 50$) and the high-and-stable subgroup (8.81%, $n = 14$) 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 levels (intercept = 14.92, $p < 0.001$, linear = 0.82, $p = 0.26$, quadratic = - 0.51, $p = 0.16$) of sport devaluation across the three waves, respectively. For physical/emotional exhaustion, the low-and-decreasing subgroup (23.90%, $n = 38$) represented athletes 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 (37.74%, $n = 60$) was comprised 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 (38.36%, $n = 61$) was comprised 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 athlete burnout, the low-decreasing-and-unstable subgroup (35.85%, $n = 57$) was comprised of athletes who experienced 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 (53.46%, $n = 85$) and the high-and-stable subgroup (10.69%, $n = 17$) 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 three waves respectively.

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

Result of a χ^2 test of sport devaluation latent classes (3) and reduced accomplishment latent classes (3) 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, inspection of Table 4 did 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%, 45.83%, 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 sport devaluation latent classes (3) and physical/emotional exhaustion latent classes (3) and of reduced accomplishment latent classes (3) and physical/emotional exhaustion latent classes (3) 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 further 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 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 ($p = 0.002$, $p = 0.02$, 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 non-significant 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 dimension 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 while 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 to 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 needed to note changes.³ Nevertheless, it is not clear how long this period needs to be.¹² Therefore, the interval of 1 month between each

measurement occasion used in the present study could have prevented us to observe a progressive increase of 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 if the 3 dimensions of the athlete burnout syndrome develop in tandem or if some burnout dimensions predict downstream changes in other dimensions (causal ordering model). There was only one 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 co-exist 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 which 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 dimension). 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 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 if 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 non-professional and professional athletes. Further research could also explore if 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.

Despite its limitations, this study was the first to provide a detailed portrait on 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 researches.

Acknowledgment

This research was supported by the French Federation of Table Tennis.

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 analyses 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

None of the authors declare competing financial interests.

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Table 1. Mean (M), standard deviation (SD), and Cronbach 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

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

	1 class	2 class	3 class	4 class	5 class
Free parameter (<i>n</i>)	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	N/A ^a	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	N/A ^a	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	N/A ^a	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	N/A ^a	117.08	71.60*	24.86*	19.22

Note: Bold entries reflect selected model.

^a Not available.

* $p < 0.05$, 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; LRT = Lo, Mendell, and Rubin Likelihood Ratio Test; LCGA = Latent Class Growth Analysis

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

	<i>n</i>	Intercept			Linear			Quadratic		
		<i>Estimate</i>	<i>SE</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>p</i>
<i>Reduced accomplishment</i>										
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

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

Reduced accomplishment	Sport devaluation	<i>n</i> (%)	Reduced accomplishment	Physical/emotional exhaustion	<i>n</i> (%)	Sport devaluation	Physical/emotional exhaustion	<i>n</i> (%)
Low-and -unstable (<i>n</i> = 54)	Low-and-unstable (<i>n</i> = 95)	44 (81.48, 46.32)*	Low-and -unstable (<i>n</i> = 54)	Low-and-decreasing (<i>n</i> = 38)	12 (22.22, 31.58)	Low-and -unstable (<i>n</i> = 95)	Low-and-decreasing (<i>n</i> = 38)	23 (24.21, 60.53)
	Moderate-and-stable (<i>n</i> = 50)	9 (16.67, 18.00)		Moderate-and-unstable (<i>n</i> = 60)	23 (42.59, 38.33)		Moderate-and-unstable (<i>n</i> = 60)	37 (38.95, 61.67)
	High-and-stable (<i>n</i> = 14)	1 (1.85, 7.14)		High-and-unstable (<i>n</i> = 61)	19 (35.19, 31.15)		High-and-unstable (<i>n</i> = 61)	35 (36.84, 57.38)
Moderate-and -unstable (<i>n</i> = 81)	Low-and-unstable (<i>n</i> = 95)	46 (56.79, 48.42)	Moderate-and -unstable (<i>n</i> = 81)	Low-and-decreasing (<i>n</i> = 38)	20 (24.69, 52.63)	Moderate-and -stable (<i>n</i> = 50)	Low-and-decreasing (<i>n</i> = 38)	12 (24.00, 31.58)
	Moderate-and-stable (<i>n</i> = 50)	30 (37.04, 60.00)		Moderate-and-unstable (<i>n</i> = 60)	31 (38.27, 51.67)		Moderate-and-unstable (<i>n</i> = 60)	17 (34.00, 28.33)
	High-and-stable (<i>n</i> = 14)	5 (6.17, 35.71)		High-and-unstable (<i>n</i> = 61)	30 (37.04, 49.18)		High-and-unstable (<i>n</i> = 61)	21 (42.00, 34.43)
High-and -unstable (<i>n</i> = 24)	Low-and-unstable (<i>n</i> = 95)	5 (20.83, 5.26)	High-and -unstable (<i>n</i> = 24)	Low-and-decreasing (<i>n</i> = 38)	6 (25.00, 15.79)	High-and -Stable (<i>n</i> = 14)	Low-and-decreasing (<i>n</i> = 38)	3 (21.43, 7.89)
	Moderate-and-stable (<i>n</i> = 50)	11 (45.83, 22.00)		Moderate-and-unstable (<i>n</i> = 60)	6 (25.00, 10.00)		Moderate-and-unstable (<i>n</i> = 60)	6 (42.86, 10.00)
	High-and-stable (<i>n</i> = 14)	8 (33.33, 57.14)		High-and-unstable (<i>n</i> = 61)	12 (50.00, 19.67)		High-and-unstable (<i>n</i> = 61)	5 (35.71, 8.20)

Note. * Over the 54 athletes composing the low and unstable trajectory of reduced accomplishment, 44 athletes (or 81.48% of these 54 athletes) 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	<i>p</i>
1. 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)			
2. 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)			
3. 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)			