Full Title: Longitudinal Internal Training Load and Exposure in a High-Performance Basketball Academy

Abstract

This study describes the longitudinal training exposure (session counts) and internal training load (Rating of Perceived Exertion; RPE and Session Rating of Perceived Exertion; sRPE) of youth basketball players at a high-performance academy, based on the training year, training term, and playing position. Historical internal training load and training exposure data were collated from 45 male high-performance youth basketball athletes between 2015 and 2019. Data included session duration, RPE, sRPE, training type and date. Linear mixed models and pairwise comparisons were performed on the weekly means and categorised by training year (Year 1, Year 2, Year 3), term (Term 1, Term 2, Term 3, Term 4) and playing position (Backcourt, Frontcourt). Linear mixed models indicate the individual athlete had the greatest influence on variance in training load and exposure. Significant differences were observed for increased session count, duration and sRPE ($p<0.001$) in Year 2 compared to Year 1. These measures also increased within each year whereby Term 3 and Term 4 ($p<0.001$) were significantly greater than Term 1 and Term 2. No significant differences were observed between playing position ($p>0.05$). Training exposure and internal training load increase in Year 2 from Year 1 for high-performance youth basketball academy athletes. Differences between training load and exposure for terms (i.e., training blocks) suggest the phase of season influences training prescription, while playing position has limited effect.

Key Words: youth, development, periodisation, monitoring

INTRODUCTION

Pathways for elite youth basketball players to the National Basketball Association (NBA) or other professional leagues are evolving, whereby athletes can opt to follow a different path to the typical route via high school and college (National Collegiate Athletics Association; NCAA)(5). The emergence of professional-like development academies provide talented high-school aged student-athletes a full-time structured basketball program to enhance their physical, technical, and tactical development, which serve as an increasingly popular pathway into professional leagues(5, 10). Often coupled with completing senior years of high-school, academies provide multi-year programs which aim to increase targeted training exposure and intensity to prepare players for the next level in their career(4, 23). These academy pathways are common and often paired with professional clubs in other sports(23), rugby and Australian Rules football(9) where descriptions of multi-year training exposure and demands provide context for player physical training development. However, there is currently limited evidence regarding the longitudinal training demands and exposure in basketball academies. These descriptions of training exposure within the developmental pathway can assist coaching and performance staff in the monitoring and management of their physical development programs.

Measuring longitudinal training load or intensity in basketball has typically been a difficult task given the limitations of available monitoring tools(18, 19, 34). A common method in many sports involves collecting perceptual measures of intensity to quantify the psychophysiological response to an external stimuli, often referred to as internal training load(21). The session Rating of Perceived Exertion (sRPE) training load (TL) modality(16) is a popular method of training load monitoring in basketball(34), and has been reported as a valid method to quantify youth basketball training sessions compared with other physiological responses such as heart rate(25, 27, 31). Given the historical lack of external load measures due to technological limitations(28, 34), sRPE has been a default tool to monitor training exposure, duration, and intensity and thus inform training prescription in basketball.

Despite the ease of internal load monitoring, currently no peer-reviewed evidence of longitudinal training exposure or training load exists in youth basketball academies. This makes it difficult to ascertain whether such academies are providing evidence-based physical development, or whether they provide sufficient preparation for athletes to successfully transition to senior (professional) basketball. The most relevant available data describes the training structure of a high-performance youth basketball academy in Spain between 1996 and 2001; where athletes are reported to experience training duration, session frequency and competition exposure increasing linearly between the ages of 14 and 17(10). The authors reported that athletes progressed from 3-4 sessions/week totalling up to 5 hours, to 5-6 sessions/week resulting in up to 12 hours/week of training(10). These findings provide descriptive insight into the macro-cycle training exposure in youth basketball increases during academy programs; however, lack description of intensity of training or the context within a training/competitive season. Furthermore, there is no data available within the last decade, with demands of the game having changed whereby the pace has increased and teams have more possessions(26), which requires further exploration to inform practice.

Whilst lacking in longitudinal data, some evidence exists in youth basketball describing acute demands of training. Brunelli et al.,(8) reports high week-to-week fluctuations in sRPE TL throughout a junior regional league pre-season and competitive season. Meanwhile, Conte et al.,(13) reported that small-sided drills with less players elicit greater perceived exertion, with Clemente et al.,(11) having reported that a greater amount of players in a drill increased the perceived exertion. Further, Klusemann et al.,(24) reported that RPE was greater in drills with less players and a larger court area. However, such information provides limited context to an extensive multi-year program. Additionally, the existing literature pertaining to internal training demands of youth basketball players does not address the apparent position-specific differences(34). Position-specific differences in basketball are distinct and important because they are dictated by the technical and tactical roles they play(36, 39) and inform the off-court physical development process(3). For instance, Svilar et al.,(38) reported greater RPE and sRPE for Guards when compared with Forwards and Centres among professional players. Such positional classifications however may not be applicable to a youth basketball academy, as player development is holistic in nature, whereby they are exposed to a wide range of skills, rather than being confined to one position. Moreover, current literature utilises state or regional level athletes who train part-time(8, 11, 13) and often of younger age(8), limiting their relevance to a full-time high-performance academy setting. An understanding of training based on position is paramount in ensuring these athletes are provided appropriate individualised training exposure to facilitate transition and future success in professional basketball.

This study aims to describe the longitudinal training exposure (session counts) and internal training load (s-RPE training load) of youth basketball players at a high-performance academy, accounting for the training year, training term and playing position.

METHODS

Experimental Approach to the Program

This study analysed historical internal training load (s-RPE training load) and training exposure (session counts) data of training sessions previously completed between 2015 and 2019 under the guidance of the same Head Coach. Given the developmental nature of the programs, and the academic commitments of the athletes, calendar years (January to December) comprise a ‘season’. While competition and tournaments are interspersed throughout the year, training is largely structured around school terms (Terms 1-4). Typically, athletes would complete morning and afternoon training sessions with schooling throughout the day from Monday through Friday, and a morning session on Saturday. Training sessions include both on-court basketball training and off-court strength and conditioning; however, measures reported within this study pertain only to the court-based basketball sessions. Specifically, basketball training sessions were led by the technical coaches, with focus on team-based training (i.e., tactical concepts), skills training (i.e., small group or positional skills including ball-handling and finishing) and shooting.

Subjects

Data from 45 male high-performance youth basketball athletes (age =17.3±0.8y, height=201.6±9.6cm, mass=93.4±14.2kg) at an academy in Australia were obtained for research purposes from appropriate stakeholders and ethical approval was granted by the relevant Human Research Ethics Committee (20220901), along with ratification from the local university ethics committee (ETH22-7841). The athletes all held scholarships in a high-performance basketball academy between 2015 and 2019. This program provides a fulltime residential basketball development program for National level players while they complete senior high school.

Procedures

Data was collected via an online mobile application, designed by high-performance staff within the Australian Institute of Sport and Basketball Australia, within 30min of completion of the session(15), where all training sessions (and where applicable, competition) were entered by players whilst part of the program. Specifically, players entered the session duration (minutes), internal training load (RPE), session type (i.e., team training, skills, shooting) and injury/training status (i.e., healthy, modified, injured) upon completion of the session. Upon induction into the academy, all players are familiarised with the mobile application, including education about RPE from the strength and conditioning coach, including the anchors of the scale. Within the study timeframe, this data collection system was continually utilised with strength and conditioning coaches provided on-boarding education of the process from the institution.

Internal training load was calculated using the s-RPE method, whereby the RPE was multiplied by the session duration (minutes) and reported in arbitrary units (AU)(16). RPE was recorded using the category-ratio 1-10 scale (CR-10)(6), which has been previously validated for use among youth basketball players(25, 30). Session duration was defined as the total duration of training (i.e., from the start of practice to the end of practice), including stoppages and the warmup. Session duration was provided to the players at the completion of the session by the strength and conditioning coach.

Training exposure can be defined as the time spent performing a particular training or competitive activity(22), and thus is reported through session volume (duration in minutes) and session count. Measures of training exposure have been typically used in literature discussing injury rates(7), however has also been used to identify training patterns in collegiate basketball(1).

Training load and training exposure data were categorised in training cycles. A training cycle is defined as seven days from Monday to Sunday, reflecting how the academy program operates. The in-season phase of competitive basketball is typically categorised into weekly microcycles containing between one and three games(14). Further to this, data is reported across training blocks, aligning to academic terms (typically 8-11 weeks in length; T1, T2, T3, T4). With this model, the terms loosely align to typical phases of a season, whereby T1 and T2 are considered ‘in-season’, T3 is largely associated with ‘off-season’ and T4 is considered ‘pre-season’. The time commitment of the athletes remains the same throughout the year, however the developmental focus shifts from basketball to physical development in T3 and T4.

Participants were categorised into two positional groups, being ‘Backcourt’ (B) and ‘Frontcourt’ (F), which reflects the evolution of the game of basketball challenging the traditional five position system(34) and aligns with how the coaches plan training and game tactics. Additionally, this categorisation may be deemed more appropriate for youth basketball programs, where exposure to a broader range of skills and playing styles, as opposed to specialisation to single position, is emphasised for effective player development. In addition, athletes were categorised based on their training environment age, referring to how many years they have been within the academy (i.e., one, two or three years; Y1, Y2, Y3) and will be based on each players scholarship commencement date.

Data was screened for compliance prior to analysis. Based on the typical training schedule, at least five out of the six (regular weeks; ≥83.3%), or four out of the five (modified weeks; ≥80%) training days must have been reported to represent a week of training. A minimum of 15 total eligible weeks and >50% of exposed opportunity (e.g., if an athlete presented data across 40 weeks, at least 20 must have been deemed eligible by the above criteria) must have been achieved to be included in the study. This resulted in a total of 45 out of 73 athletes eligible for inclusion, with n = 37, n = 33 and n = 9 providing data points in Y1, Y2 and Y3 respectively. Of the 45 athletes, 18 were classified as Backcourt while 27 were classified as Frontcourt.

Statistical Analyses

Prior to analysis, assumptions of variance and independence were checked utilising Levene's and Shapiro-Wilk test's respectively and scatterplots and Cook's Distance were used to determine potential influential data points, though no points were deemed to have a major effect on the model. Four mixed models were created, one for each outcome variable (i.e., session count, duration, RPE and sRPE) whereby the fixed effects were training year, term and playing position. To account for individual differences, a random intercept was set at the individual athlete level. This allowed an examination of the effect the fixed variables on the outcome variables. Mixed modelling was used for its ability to cope with unbalanced and repeated-measures data(12). For all fixed factors, pairwise differences were assessed post hoc using Tukey's HSD. Significance was set at $p \leq 0.05$. Statistical analyses were conducted in R Studio (Version 4.2, R Core Team) using the lme4 and lmerTest packages.

RESULTS

Insert Table 1 here

Session Count

For session count (Table 1), training year, term and position respectively accounted for ~2% of variance in sessions/week. The random effect of the individual athlete accounted for ~35% variance when combined with training year and term, and ~32% when combined with position. As shown in Figure 1, pairwise comparisons indicate session counts/week in Y2 ($p<0.001$) and Y3 ($p=0.002$) were significantly higher than Y1. Count of sessions/week in T2 ($p=0.012$), T3 ($p=0.001$) and T4 ($p<0.001$) were significantly lower than T1 (Figure 2). No significant differences were observed between positions for sessions ($p=0.2$) (Figure 3).

Insert Fig 1, 2 and 3 near here

Duration

For duration (Table 1), training year, term, and position each accounted for ~2% variation in training duration/week. When considering the individual athlete as a factor combined with training year and training term, 37% variance was explained, while ~32% was explained when combined with position. As per Figure 1, pairwise comparisons indicate total weekly duration in Y2 ($p<0.001$) was significantly greater than Y1, and Y3 ($p=0.006$) was significantly less than Y1. Total weekly duration in T2 ($p<0.001$), T3 ($p<0.001$) and T4 ($p<0.001$) were significantly lower than T1 (Figure 2). T3 ($p=0.036$) total weekly duration was significantly less than T2. No significant differences were observed between positions ($p=0.2$) (Figure 3).

Ratings of Perceived Exertion

For RPE, training year ($R^2 = 0.002$), term ($R^2 = 0.004$) or position ($R^2 = 0.004$) did not explain variation (<1%). When combined with the individual athlete as a random factor training year, term and position accounted for ~47% of the variation in RPE. Pairwise comparisons do not indicate significant differences between years (Figure 1). For terms, T2 was significantly greater than T1 ($p=0.023$) and T3 ($p=0.009$) (Figure 2). No significant differences were observed between positions ($p=0.156$) (Figure 3).

Internal Training Load (sRPE)

For weekly sRPE training load, training year, term and position individually accounted for ~2% in variation. When combined with the individual athlete as a random factor, training year, term and position explain 35%, 34% and 32% of variation respectively. Pairwise comparisons indicate weekly sRPE in Y2 ($p<0.001$) and Y3 ($p=0.007$) were significantly greater than Y1 (Figure 1). Weekly sRPE in T3 ($p<0.001$) and T4 ($p<0.001$) were significantly less than T1, while T3 ($p<0.001$) and T4 (0.020) were significantly less than T2 (Figure 2). No significant differences were observed between positions ($p=0.112$) (Figure 3).

Discussion

To the authors' knowledge, this study is the first to describe the longitudinal exposure to training and internal training load among high-performance youth basketball academy athletes while also examining the relationship between internal training load with training year, term and playing position. Firstly, the outcomes of this study indicate that athletes report higher weekly training exposure, duration, and internal load (sRPE) in their second year compared with their first. Secondly, within a year, training exposure, duration, intensity (RPE) and internal load (sRPE) differed by training block, whereby they were greater in the first half of the year (i.e., T1 and T2) than the second half of the year (i.e., T3 and T4). In addition, the individual athlete had the greatest impact on changes in training exposure and training load, while playing position had limited to no effect. Collectively, this study provides novel data that will better inform the training practices of multi-year youth basketball academies by providing reference points for practitioners of the training exposure, intensity and load that is present when developing high-performance basketball players.

Our results showed increases in session count, duration, and internal training load per week between Y1 and Y2, although limited changes in RPE. Similar progression has been reported within a Spanish basketball academy, where athletes begin at 14 years-of-age completing 3-4 sessions/week at 75min/session and train up until 17 years-of-age and complete 6 sessions/week at 135min/session(10). This linear progression within a youth cohort is paramount in ensuring athlete wellbeing(4) while still adequately developing their technical, tactical, and physical capacities(10). The increased training exposure presented in our study by means of sessions/week (7.8±2.4 vs 8.0±2.4) and duration/week (611±215min vs 629±205min) and resultant increase in sRPE training load (3696±1458AU vs 3853±1365AU) demonstrate small increases between training years 1 and 2. Although Y3 displayed significantly greater sessions/week, duration/week and sRPE/week than Y1, the same linear progression was not observed from Y2 to Y3. A possible explanation for this may be the unique nature of the academy whereby limited athletes remain in the program for 3 years, or that a larger proportion of their weekly exposure and load is attributed to increased competition frequency. Similarly, Spanish basketball academy athletes showed the number of competitive matches per year increases year-to-year (from 20 at 14yrs to >40 at 17yrs)(10). The results of this study provide reference points of the training demands of youth basketball academies and provide practitioners at the senior/professional level an understanding of the training base of incoming athletes, to aid the transition from youth to senior basketball.

The results of this study support the notion that the level of athlete and/or competition they compete in may influence the intensity and volume of training(32). For example, Arede et al.,(2) described perceived training demands in a national team selection camp, where the RPE of training sessions were 4.7±0.96, which is lower than the weekly RPE (5.80–6.13) described in this study. Meanwhile Lupo et al.,(25) concluded that regular season training sessions were reported at 6.7±1.3 on the Borg CR-10 scale by state level youth players. In-season (i.e., T1 and T2) average weekly RPE from this study range between 5.8 and 6.1, with the disparity supporting previous findings. Previously, weekly training loads across an eight-week in-season training block among regional level juniors (12 years of age) reported between 707AU and 1753AU/week(8), which is far less than the loads reported in this study (i.e., upwards of 3600AU per week). Much of this difference is likely attributed to the number and duration of training sessions completed by the groups in the week, associated with the level of athlete and thus the expectations of the training environment. This too seems evident within a Spanish high-performance basketball academy, whereby in their second-year athletes typically complete more training each week than those in their first year. Whilst senior semi-professional players are reported to complete between 1064AU and 2233AU of work in a week, including competition(17), though these competition demands don't reflect a typical week within a national youth basketball academy. As such, practitioners should be aware of the level of athlete reported in the literature when seeking comparisons for training plans and look to cater individually to the level of athlete they are working with.

Competitive basketball seasons are typified by a short pre-season (6-8 weeks) and long in-season (8 months)(33), which is somewhat reflected by the typical annual calendar within the high-performance youth basketball academy. However, given the difference in the overall aims of the academy (i.e., long-term athlete development as opposed to short-term success), periodisation of training may be atypical to that of a professional environment. Our results showed significant differences in training loads between training blocks (i.e., terms) across the year, whereby they were greater in the first half of the year (i.e., T1 and T2) than the second half of the year (i.e., T3 and T4). A possible explanation for this may be due to the shift in training priorities. T3 and T4 within the academy consist of 'offseason' and 'preseason' training, with an increased focus on physical development including aerobic and anaerobic conditioning as well as speed and agility training. Whilst the time commitment of the athletes to training remains the same, this increased and targeted exposure to physical preparation results increased load(20) from greater perceived exertion. Although T1 and T2 comprise the competitive season, the primary focus of the academy remains developmental as opposed to performance. As such, training load and exposure may still be greater among this group when compared to semi-professional and professional players. For example, Russell et al.,(35) presented weekly training duration of NBA athletes with starting players completing 215mins, rotation players completing 301mins and bench players completing 302mins during the regular season. In contrast, academy athletes completed upwards of 500mins of training/week. Whilst this discrepancy may be lessened when competition minutes are included, it highlights the difference between a developmental and performance setting, and the increased training exposure implemented to prepare junior athletes for senior basketball.

Although there is a general consensus that playing position affects training loads in basketball(34), this was not evident in the current study. Positional differences in loads seem more prominent in literature utilising external training load measures, suggesting internal training load measures may be less sensitive to position-specific demands. Professional basketballers report stable RPEs across positional groups, though guards report higher sRPE than forwards and centres(38). We present similar findings in this study where backcourt players report 4148±1385AU per week while frontcourt players report 3614±1223AU, with RPE remaining similar at 6.0±0.9 and 6.0±1.0 respectively. The results of the LMM suggest that the individual athlete has substantially greater impact on internal load than playing position, aligning with the principle of specificity and individuality in basketball(29, 38). This high athlete-to-athlete variation in training loads highlights the need for a detailed monitoring process in a basketball academy setting, whereby daily training modifications may be required at the individual level based on an athlete's responses to a training dose.

Whilst this investigation presents a novel study describing the longitudinal training demands of a high-performance youth basketball academy, it is not without limitations. Despite sRPE data being collected under the supervision of the academies experienced performance staff using validated protocols, self-reported training load poses the potential of missing data(37). Unfortunately, given the applied nature of this study and the fact the dataset is retrospective, this is unavoidable. Additionally, given that RPE is an output and different activities can lead to the same RPE, additional information would be beneficial to discern between RPE responses in training. Provided the limited cohort of the academy, a low statistical power given the small cohort for Y3 athletes may have influenced the results of this group. However, this is unavoidable given the applied nature of the study and period in which it was undertaken, and the unique nature of the academy setting.

This study described the training exposure and internal training load experienced by athletes in a high-performance youth basketball academy and investigated the relationship of these measures with training age, term and playing position. Training year and training term influenced the number of training sessions, duration and sRPE TL athletes reported in a week. Athletes in their second year reported a greater exposure to training (sessions/week) and internal training load (sRPE) than those in their first year. In addition, significant differences between terms indicate the use of periodisation strategies, resulting in greater training exposure and training load at the beginning of the year (i.e., T1 and T2) during the in-season phase. The outcomes of this study could be used as reference points of training exposure and training demands in high-performance youth basketball, while also supporting the use of perceptual measures of training load in youth basketball. Future research should look to quantify the longitudinal training demands in a high-performance basketball academy at a more granular level (e.g., external training loads).

PRACTICAL APPLICATIONS

Collectively, the findings of this study provide a description of the training exposure and training demands experienced within a high-performance youth basketball academy that previously did not exist. This knowledge may assist coaches and performance practitioners in preparing their athletes for transition into such an environment or assist practitioners who begin working with an athlete transitioning out of this environment into a new training program. A thorough understanding of the frequency, intensity and volume of training completed may allow for a more effective and efficient transition from junior to senior basketball. In addition, recognition of the athletes training age allows coaching staff to ensure progression of training exposure and demands continues. Furthermore, emerging high-performance youth basketball academies may wish to use this data to inform the development of their weekly training structure and schedules.

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Table 1. Results of each of the four mixed models

Model 1 - Session Count			Model 2 - Duration			Model 3 - RPE			Model 4 - sRPE		
Predictors	*Estimates*	*CI*	*Predictors*	*Estimates*	*CI*	*Predictors*	*Estimates*	*CI*	*Predictors*	*Estimates*	*CI*
Year 1	7.48 ***	7.01 – 7.96	Year 1	585.04 ***	542.72 – 627.37	Year 1	5.95 ***	5.74 – 6.16	Year 1	3578.84 ***	3302.61 – 3855.08
Year 2	0.61 ***	0.35 – 0.87	Year 2	48.89 ***	26.37 – 71.41	Year 2	0.10 *	0.00 – 0.19	Year 2	338.83 ***	185.59 – 492.07
Year 3	1.02 ***	0.42 – 1.62	Year 3	78.66 **	27.26 – 130.06	Year 3	0.07	-0.14 – 0.29	Year 3	529.18 **	180.49 – 877.87
σ2		4.5	σ2		32838.97	σ2		0.54	σ2		1524121.13
τ00		2.32 Name	τ00		18408.08 Name	τ00		0.47 Name	τ00		774844.72 Name
ICC		0.34	ICC		0.36	ICC		0.47	ICC		0.34
Marginal R^2 / Conditional R^2		0.018 / 0.352	Marginal R^2 / Conditional R^2		0.015 / 0.369	Marginal R^2 / Conditional R^2		0.002 / 0.467	Marginal R^2 / Conditional R^2		0.016 / 0.347
Term 1	8.27 ***	7.80 – 8.74	Term 1	663.37 ***	621.31 – 705.44	Term 1	5.95 ***	5.73 – 6.16	Term 1	4052.09 ***	3773.20 – 4330.97
Term 2	-0.47 **	-0.77 – -0.17	Term 2	-49.12 ***	-74.70 – -23.53	Term 2	0.15 **	0.05 – 0.26	Term 2	-197.12 *	-371.76 – -22.47
Term 3	-0.58 ***	-0.89 – -0.27	Term 3	-85.25 ***	-111.58 – -58.93	Term 3	-0.02	-0.13 – 0.09	Term 3	-551.55 ***	-731.20 – -371.90
Term 4	-0.83 ***	-1.14 – -0.52	Term 4	-80.30 ***	-106.67 – -53.93	Term 4	0.06	-0.04 – 0.17	Term 4	-464.73 ***	-644.70 – -284.75
σ2		4.51	σ2		32307.5	σ2		0.54	σ2		1505218.67
τ00		2.02 Name	τ00		16709.78 Name	τ00		0.48 Name	τ00		724126.67 Name
ICC		0.31	ICC		0.34	ICC		0.47	ICC		0.32
Marginal R^2 / Conditional R^2		0.014 / 0.320	Marginal R^2 / Conditional R^2		0.024 / 0.357	Marginal R^2 / Conditional R^2		0.004 / 0.471	Marginal R^2 / Conditional R^2		0.021 / 0.339
Backcourt	8.16 ***	7.48 – 8.84	Backcourt	641.79 ***	580.33 – 703.24	Backcourt	6.07 ***	5.74 – 6.40	Backcourt	4007.87 ***	3608.44 – 4407.30
Frontcourt	-0.57	-1.45 – 0.30	Frontcourt	-51.25	-130.58 – 28.07	Frontcourt	-0.13	-0.55 – 0.30	Frontcourt	-417.54	-933.13 – 98.05
σ2		4.59	σ2		33383.73	σ2		0.54	σ2		1549167.9
τ00		2.00 Name	τ00		16467.30 Name	τ00		0.49 Name	τ00		690715.54 Name
ICC		0.3	ICC		0.33	ICC		0.47	ICC		0.31
Marginal R^2 / Conditional R^2		0.012 / 0.312	Marginal R^2 / Conditional R^2		0.012 / 0.339	Marginal R^2 / Conditional R^2		0.004 / 0.473	Marginal R^2 / Conditional R^2		0.018 / 0.321

*Note: Estimates may also be noted as coefficients. CI = Confidence intervals set at 95%.. σ2 = within-person variance. T00 = between-person variance. ICC = Intraclass Correlation Coefficient. Marginal R2 = fixed effects. Conditional R2 = fixed + random effects. * p<0.05 ** p<0.01 *** p<0.001*

Fig 1. Training Exposure and Internal Training Load by Training Year. * = p<0.05; ** = p<0.01; *** = p<0.001.

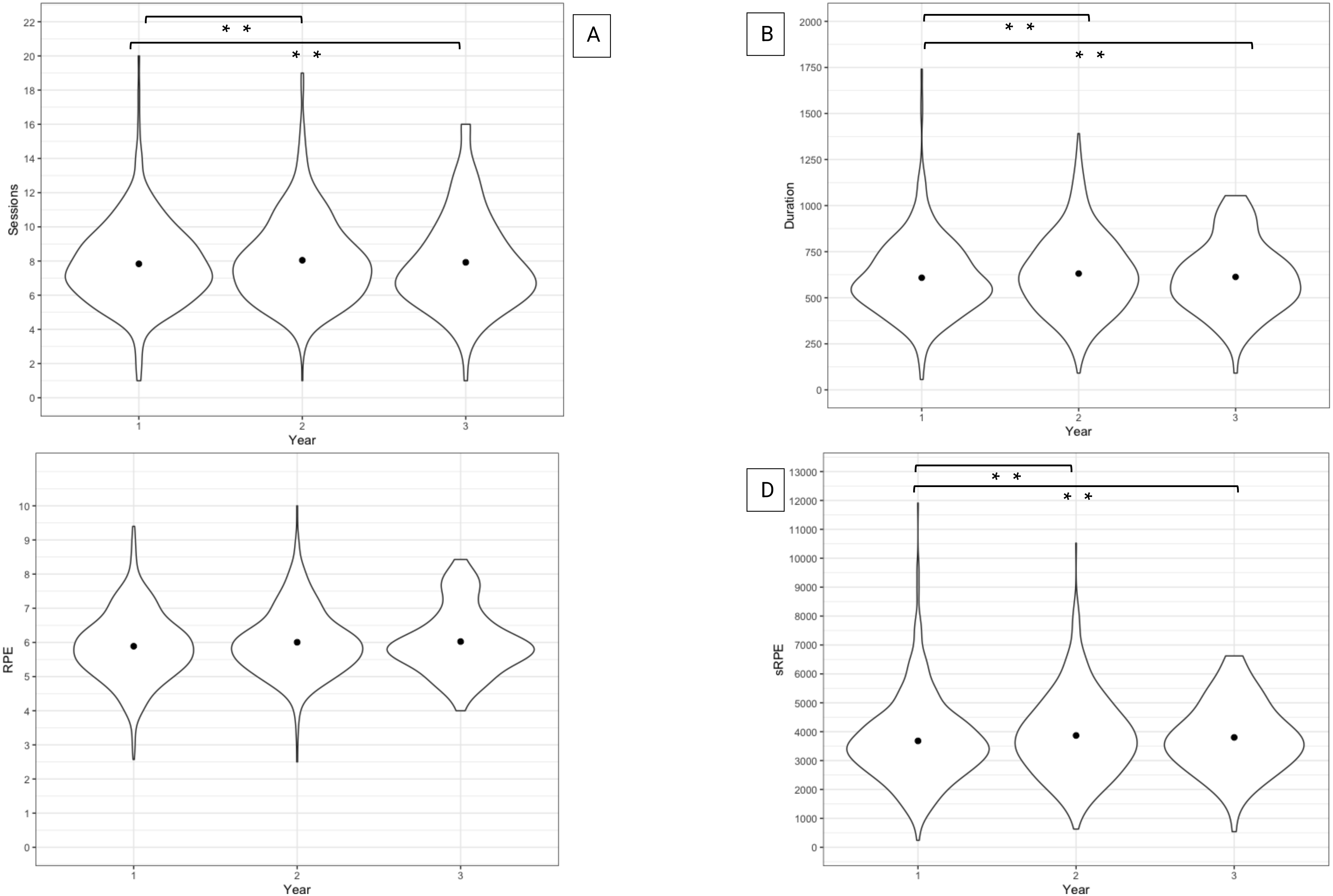

Fig. 2 Training Exposure and Internal Training Load by Term. * = p<0.05; ** = p<0.01; *** = p<0.001.

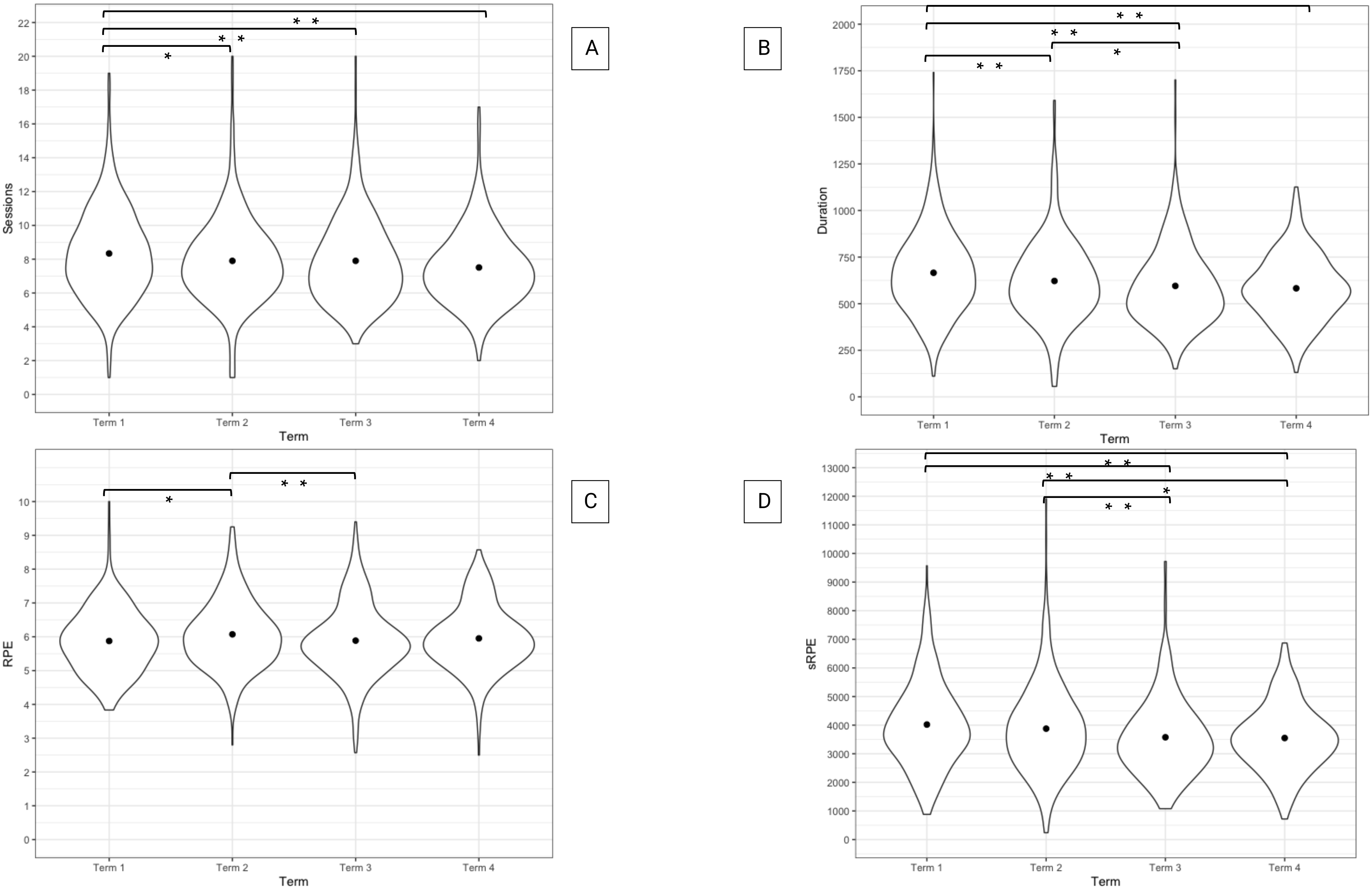

Fig. 3 Training Exposure and Internal Training Load by Position. * = p<0.05; ** = p<0.01; *** = p<0.001.