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Analysis of the Relationship Between Training Load and Recovery Processes in an Active Lifestyle and Muscle Fatigue in Amateur Padel Players

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Abstract. This study examined the relationship between training load and recovery processes associated with an active lifestyle and muscle fatigue in amateur padel players. A quantitative correlational approach was used, involving 15 amateur padel players in South Tangerang. Training load was measured using Session-RPE, recovery processes via the Total Quality Recovery (TQR) questionnaire, and muscle fatigue via the difference in Countermovement Jump (CMJ) test results before and after playing sessions. The Shapiro-Wilk normality test indicated that the training load data were not normally distributed (Sig. = 0.011), so the Spearman correlation test was used. The results showed no significant relationship between training load and muscle fatigue (r = –0.200; Sig. = 0.475), nor between recovery and muscle fatigue (r = 0.280; Sig. = 0.312). The multiple regression analysis yielded an R value of 0.453 with Sig. = 0.253. Although not statistically significant, the direction of the correlation is consistent with theory and is likely influenced by the small sample size and high individual variability within the amateur population.

Keywords: training load; recovery; muscle fatigue; padel; session-RPE; CMJ

INTRODUCTION

Padel is growing rapidly in Indonesia. The number of padel courts is reported to have surged from 240 in 2024 to 947 in 2025, a growth of approximately 435% in just one year (Setyawan et al., 2025). Behind its rising popularity, padel actually demands a fairly high level of physiological capacity. Mellado-Arbelo & Baiget (2022) classify padel as a high-intensity intermittent sport, involving sprints, sudden changes in direction, and explosive movements that occur repeatedly during a single session. Marcos-Rivero et al. (2025) noted an average of more than 600 accelerations and nearly 420 meters of explosive distance in a single padel match.

Such physiological demands directly impact the accumulation of training load. When the load is not properly monitored, the risk of muscle fatigue increases. Muscle fatigue itself is defined as a condition in which muscles are no longer able to maintain the required force due to continuous activity (Lima-Alves et al., 2022). Impellizzeri et al. (2019) emphasize that training load that is not systematically managed can accelerate the accumulation of fatigue and ultimately increase the risk of long-term injury. Research in racket sports shows that athletes' neuromuscular responses are significantly influenced by the quality of stimuli received during training, where technology-based approaches have proven more effective in training reaction and motor adaptation abilities than conventional methods (Cahyadi & Aziz, 2025).

The recovery process is a critical variable that is often overlooked, especially among individuals with active lifestyles. Unlike professional athletes, who have structured recovery programs, amateur padel players generally rely on their daily routines for recovery—specifically, sleep quality, nutritional intake, hydration, and psychological well-being (Parwata, 2015). Dudley et al. (2023) found that a combination of load monitoring and consistently planned recovery strategies is associated with a reduced incidence of injuries across various sports. Durdel & Ryman Augustsson (2025) specifically found among young padel players that high weekly training loads without adequate recovery are directly correlated with the risk of injury in the following week. In non-elite populations, the body's ability to recover and maintain neuromuscular performance depends heavily on the quality of the training program, including how training load is applied and consistently monitored from session to session (Putri et al., 2025).

Unfortunately, nearly all existing studies on the physiology of padel have focused solely on professional players in Europe (Mellado-Arbelo & Baiget, 2022; Marcos-Rivero et al., 2025). No study has yet comprehensively examined the relationship among these three variables in amateur players in Indonesia. This study aims to fill this gap by analyzing training load (X_1) using the Session-RPE method (Foster et al., 2001; Haddad et al., 2017), active lifestyle recovery (X_2) via the Total Quality Recovery (TQR) questionnaire (Parwata, 2015), and muscle fatigue (Y) through the difference in Countermovement Jump (CMJ) test results before and after a padel session (Collins et al., 2025; Marcos-Rivero et al., 2025).

METHOD

This study employed a quantitative approach with a cross-sectional correlational design, in which all variables were measured within a single session per subject (Sugiyono, 2019). This design was selected as an initial exploratory approach appropriate for examining covariance among training load, recovery, and muscle fatigue within the same observational window. The subjects consisted of 15 amateur padel players recruited through the Reclub platform in South Tangerang using purposive sampling. Inclusion criteria were: (1) actively playing padel at least twice per week; (2) minimum six months of playing experience; (3) not registered in any structured professional coaching program; (4) not competing in any national-level tournament; (5) free from active musculoskeletal injury at the time of the study; and (6) willing to sign an informed consent form (Sugiyono, 2017).

Training load (X_1) was measured using Session-RPE, which is the product of the perceived exertion score on the Borg CR-10 scale and the duration of the training session in minutes, resulting in a score in arbitrary units (AU). The questionnaire was completed 30 minutes after the session ended so that the assessment would accurately reflect the entire session (Foster et al., 2001; Haddad et al., 2017). Active lifestyle recovery (X_2) was measured using the Total Quality Recovery (TQR) questionnaire (scale 6–20), covering the dimensions of sleep quality, nutritional intake, hydration, and psychological state, completed every morning prior to the session (Parwata, 2015). The TQR was selected because it was originally developed for use in non-elite, recreationally active populations whose recovery depends primarily on daily lifestyle habits rather than structured post-exercise protocols (Kenttä & Hassmén, 1998, as cited in Parwata, 2015).

Unlike laboratory-based biomarkers, the TQR captures holistic recovery status in a single instrument that is ecologically valid for field-based studies involving amateur athletes. While instruments such as the Pittsburgh Sleep Quality Index (PSQI) or dietary recall forms could provide more granular data on individual dimensions, the TQR was retained in this study to maintain feasibility and consistency with the field conditions of amateur padel players. Muscle fatigue (Y) was measured via the Countermovement Jump (CMJ) test using the My Jump Lab application, which has been validated as a reliable field-based neuromuscular assessment tool (Stanton et al., 2017). The test was performed with hands fixed on hips throughout to eliminate the contribution of arm swing and minimise inter-trial variability. Each subject completed three trials both before the session (pre-test) and 15–30 minutes after the padel session ended (post-test), with a 30-second rest interval between trials. The best score from each testing phase was recorded as the final value. The difference between pre- and post-test CMJ scores served as the primary indicator of acute neuromuscular fatigue, consistent with the protocol used in previous padel research (Collins et al., 2025; Marcos-Rivero et al., 2025).

The data were analyzed using SPSS in three stages: the Shapiro-Wilk normality test, Spearman's correlation test (since the distribution of X_1 was not normal), and multiple linear regression to examine the simultaneous effects of X_1 and X_2 on Y (Sugiyono, 2013). The significance level was set at $\alpha = 0.05$.

RESULT AND DISCUSSION

The training load data (X_1) from 15 respondents are presented in Table 1. The sRPE values ranged from 180 to 420 AU, reflecting the characteristic diversity in playing patterns among amateur players who do not follow a structured training program (Impellizzeri et al., 2019). TQR scores, as a measure of active lifestyle recovery (X_2), ranged from 9 to 18, with considerable variation reflecting differences in each player's daily habits (Parwata, 2015). CMJ test results showed a similarly high degree of variation in neuromuscular responses, with some players experiencing a decline in CMJ performance after the session, while others actually showed an improvement (Collins et al., 2025).

Table 1. Training Load Data: Session-RPE (X_1)

No	Subject	sRPE (Borg CR-10)	Duration (Minute)	Training Load (AU)
1	A	3	60	180
2	B	5	60	300
3	C	7	60	420

4	D	3	60	180
5	E	3	60	180
6	F	3	60	180
7	G	5	60	300
8	H	5	60	300
9	I	5	60	300
10	J	3	60	180
11	K	7	60	420
12	L	4	60	240
13	M	5	60	300
14	N	7	60	420
15	O	5	60	300

Table 2.Total Quality Recovery Data (X_2)

No	Subject	age	height (cm)	Body weight (kg)	Skor TQR
1	A	24	174	64	14.5
2	B	23	170	65	13
3	C	25	167	65	16.5
4	D	30	164	77	16
5	E	25	171	87	15
6	F	24	171	75	18
7	G	23	169	69	14
8	H	24	163	55	15.5
9	I	23	165	75	16
10	J	22	173	106	12
11	K	20	168	75	12
12	L	23	176	85	9
13	M	24	165	55	13
14	N	23	176	75	18
15	O	23	174	86	15

Table 3. Counter-Movement Jump Test Results (Y)

No	Subject	Before session (cm)	After session (cm)	Difference (cm)
1	A	57.2	47.3	9.9
2	B	39.9	49.2	-9.3
3	C	52.4	45.9	6.5
4	D	44.8	39.4	5.4
5	E	33.8	38.2	-4.4
6	F	52.4	40.0	12.4
7	G	44.1	42.3	1.8
8	H	38.8	41.6	-2.8
9	I	34.9	38.7	-3.8
10	J	38.2	36.6	1.6
11	K	42.3	37.5	4.8
12	L	43.5	58.0	-14.5
13	M	47.3	45.4	1.9
14	N	40.0	47.3	-7.3
15	O	29.6	35.5	-5.9

The Shapiro-Wilk normality test indicates that the X_1 data are not normally distributed (Sig. = 0.011), while X_2 (Sig. = 0.663) and Y (Sig. = 0.987) are normally distributed. Since one independent variable does not meet the assumption of normality, the overall correlation analysis uses the Spearman test to maintain consistency (Sugiyono, 2013).

Table 4. Test of Normality

Shapiro-Wilk		
Statistic	df	sig.
0.835	15	0.011
0.958	15	0.663
0.983	15	0.987

The results of the Spearman test showed that there was no significant relationship between training load and muscle fatigue (r = –0.200; Sig. = 0.475), nor between recovery and muscle fatigue (r = 0.280; Sig. = 0.312). The multiple regression analysis yielded R = 0.453, R-squared = 0.205, and Sig.F = 0.253, indicating that X_1 and X_2 together explain only 20.5% of the variation in muscle fatigue and are not statistically significant.

Table 5. Correlations

			x1	x2	y
Spearman's rho	x1	Correlation Coefficient	1.000	.097	-.200
		Sig. (2-tailed)	.	.732	.475
		N	15	15	15
	x2	Correlation Coefficient	.097	1.000	.280
		Sig. (2-tailed)	.732	.	.312
		N	15	15	15
	y	Correlation Coefficient	-.200	.280	1000
		Sig. (2-tailed)	.475	.312	.
		N	15	15	15

Table 6. Model Summary

				Change Statistics			
R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df 1	df 2	Sig. F Change
.453[a]	.205	.072	7.1942	.205	1.547	2	12	.253

Table 7. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	160.122	2	80.061	1.547	.253[b]

Residual	621.076	12	51.756		
Total	781.197	14			

It is also important to acknowledge that no consensus currently exists regarding safe internal training load thresholds specific to amateur padel players. Unlike professional sport contexts where session-RPE benchmarks have been empirically established, recreational players lack reference norms against which their load can be evaluated. The sRPE values recorded in this study ranged from 180 to 420 AU, a range that in other intermittent sports such as football would be considered low to moderate (Impellizzeri et al., 2019), but their practical significance for this population remains unclear without population-specific reference data. This absence of established thresholds is itself a finding of relevance, as it highlights the need for longitudinal monitoring studies in amateur padel communities to build normative datasets that could inform safer training practices.

Although it did not reach the level of significance, the direction of the correlation that emerged is still consistent with the existing theoretical framework. Training load was negatively correlated with CMJ performance (r = –0.200), meaning that the higher the load, the greater the tendency for a decline in jumping ability as an indicator of neuromuscular fatigue. Meanwhile, recovery is positively correlated with CMJ (r = 0.280), meaning that better recovery tends to maintain neuromuscular performance. This pattern is consistent with the findings of Impellizzeri et al. (2019), who noted that the relationship between load and fatigue is gradual and often undetectable in a single measurement within a single session.

This lack of significance can be explained by several factors. First, the small sample size (n=15) severely limited the statistical power of the Spearman test to detect small- to moderate-sized effects. Cahyadi & Aziz (2025), in a study on racket sports with a similar sample size, noted that the large variation in physiological responses among individuals was a major obstacle to producing statistically stable correlations. Second, the highly variable characteristics of amateur players. Putri et al. (2025) emphasized that in non-elite populations, neuromuscular responses are strongly influenced by individual factors such as sleep habits, dietary patterns, and daily stress levels. Factors that are difficult to fully control in a correlational study design. Third, measurements were taken in a single session, whereas muscle fatigue in intermittent sports like padel is cumulative and dynamic, meaning a single measurement point is not sensitive enough to capture its

variations (Marcos-Rivero et al., 2025; Durdel & Ryman Augustsson, 2025). Fourth, the Session-RPE and TQR instruments rely on subjective perceptions; untrained amateur players may not provide precise assessments, which could potentially introduce noise into the data (Haddad et al., 2017).

Several limitations of this study warrant acknowledgment. First, the small sample size (n=15) substantially reduced statistical power, making it difficult to detect small-to-moderate effect sizes that may genuinely exist between the variables. A minimum sample of 30 participants is generally recommended for Spearman correlation analyses to produce stable estimates (Sugiyono, 2013). Second, the cross-sectional single-session design captured only a snapshot of the relationship between training load, recovery, and muscle fatigue at one point in time. Given that muscle fatigue in intermittent sports is cumulative in nature, a design involving repeated measurements over several weeks would more accurately reflect the dynamic interplay between these variables (Marcos-Rivero et al., 2025; Durdel & Ryman Augustsson, 2025). Third, both Session-RPE and TQR rely on subjective self-report, which may introduce response bias, particularly among amateur players who are unfamiliar with rating perceived exertion accurately (Haddad et al., 2017). Fourth, the absence of established training load thresholds for amateur padel players makes it difficult to contextualise whether the observed sRPE values (180–420 AU) represent a meaningful physiological stimulus for this population (Impellizzeri et al., 2019).

Future research should address these limitations by employing larger and more diverse samples of amateur padel players across multiple regions of Indonesia. Longitudinal monitoring designs spanning four to eight weeks of repeated measurement would better capture the cumulative nature of fatigue and recovery in this population. The integration of objective physiological markers, such as heart rate variability (HRV) for recovery assessment and force plate measurements for neuromuscular fatigue, alongside subjective instruments would strengthen the validity of findings. Additionally, establishing population-specific normative data for training load in Indonesian amateur padel players would provide a critical reference framework for coaches, sports practitioners, and future researchers working in this rapidly growing sport context.

CONCLUSION

This study concluded that there was no significant relationship between training load (X_1) and recovery through an active lifestyle (X_2) and muscle fatigue (Y) among amateur padel players in South Tangerang, either partially or simultaneously. Nevertheless, the direction of the correlations found remains consistent with theory: higher training load tends to decrease CMJ performance, while better recovery quality tends to maintain neuromuscular capacity.

These nonsignificant results reflect methodological limitations, particularly the small sample size and single-session measurements, rather than the absence of a substantive relationship between the variables. Further research with a larger sample, a longitudinal design, and repeated measurements is strongly recommended to verify this relationship more comprehensively in the context of Indonesian amateur padel players.

REFERENCES

Cádiz Gallardo, M. P., Pradas de la Fuente, F., Moreno-Azze, A., & Carrasco Páez, L. (2023). Physiological demands of racket sports: A systematic review. Frontiers in Psychology, 14(March), 1–9. https://doi.org/10.3389/fpsyg.2023.1149295

Cahyadi, R. I., & Aziz, M. I. M. (2025). Revolusi pelatihan kelincahan tenis: Integrasi teknologi BlazePod untuk meningkatkan performa di lapangan. Journal Penjaskesrek, 12(1), 66–79.

Collins, J. J., Malone, S., & Collins, K. D. (2025). Associations between internal and external training load measures and neuromuscular performance in elite soccer players. Sport Sciences for Health, 21(3), 1575–1582. https://doi.org/10.1007/s11332-025-01371-4

Courel-Ibáñez, J., Villanueva-Guzmán, R., García-Benito, A., & Sánchez-Pay, A. (2020). Exploring game dynamics in padel. Frontiers in Psychology, 11, 61.

Dudley, C., Johnston, R., Jones, B., Till, K., Westbrook, H., & Weakley, J. (2023). Methods of monitoring internal and external loads and their relationships with physical qualities, injury, or illness in adolescent athletes: A systematic review and best-evidence synthesis. Sports Medicine, 53(8). https://doi.org/10.1007/s40279-023-01844-x

Durdel, L., & Ryman Augustsson, S. (2025). Training load, injuries, and well-being in youth padel players: A cross-sectional study. Sports, 13(10), 356.

Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., Doleshal, P., & Dodge, C. (2001). A new approach to monitoring exercise training. Journal of Strength and Conditioning Research, 15(1), 109–115.

Haddad, M., Stylianides, G., Djaoui, L., Dellal, A., & Chamari, K. (2017). Session-RPE method for training load monitoring: Validity, ecological usefulness, and influencing factors. Frontiers in Neuroscience, 11. https://doi.org/10.3389/fnins.2017.00612

Impellizzeri, F. M., Marcora, S. M., & Coutts, A. J. (2019). Internal and external training load: 15 years on. International Journal of Sports Physiology and Performance, 14(2), 270–273.

Lima-Alves, A., Claudino, J. G., Boullosa, D., Couto, C. R., Teixeira-Coelho, F., & Pimenta, E. M. (2022). The relationship between internal and external loads as a tool to monitor physical fitness status of team sport athletes: A systematic review. Biology of Sport, 39(3), 629–638. https://doi.org/10.5114/BIOLSPORT.2022.107021

Marcos-Rivero, B., Yanci, J., Granados, C., Picabea, J. M., & Ascondo, J. (2025). Evolution of physiological responses and fatigue analysis in padel matches according to match outcome and playing position. Sensors, 25(17), 1–14. https://doi.org/10.3390/s25175240

Mellado-Arbelo, O., & Baiget, E. (2022). Activity profile and physiological demand of padel match play: A systematic review. Kinesiology, 54(1), 51–61. https://doi.org/10.26582/k.54.1.6

Parwata, I. M. Y. (2015). Kelelahan dan recovery dalam olahraga. Jurnal Pendidikan Kesehatan Rekreasi, 1, 2–18.

Putri, A., Mulyana, Firdaus, I. R., & Ajid, O. N. (2025). The effect of quickness and flexibility training on increasing the reaction time of the sickle kick in the sport of pencak silat. Journal of Physical Education, Sport, Health and Recreation, 14(2), 743–747.

Sánchez-Alcaraz, B. J., Courel-Ibáñez, J., & Cárdenas, D. (2021). Padel research in the last decade: A systematic review. International Journal of Human Movement and Sports Sciences, 9(1), 68–74.

Setyawan, M. N., Syafruddin, M. A., Sutriawan, A., Iskandar, & Hakim, H. (2025). Pengenalan olahraga padel sebagai alternatif aktivitas rekreasi sehat di era modern. PROFICIO: Jurnal Pengabdian Kepada Masyarakat, 7(1), 461.

Stanton, R., Wintour, S. A., & Kean, C. O. (2017). Validity and intra-rater reliability of MyJump app on iPhone 6s in jump performance. Journal of Strength and Conditioning Research, 31(10), 2820–2826. https://doi.org/10.1519/JSC.0000000000001901

Sugiyono. (2013). Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D. Alfabeta.

Sugiyono. (2017). Metode penelitian kuantitatif, kualitatif, dan R&D. Alfabeta.

Sugiyono. (2019). Metode penelitian kuantitatif, kualitatif, dan R&D (Edisi ke-2). Alfabeta.