External and Internal Training Load Adaptability of Basketball Athletes in a Selected University in Chengdu, China

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ABSTRACT

This study aimed to assess the internal and external training load adaptability of selected collegiate student-athletes, with a particular focus on identifying variations based on demographic and athletic profiles such as year level, playing experience, position, and weekly training hours. Utilizing a descriptive-comparative research design, data were collected from 60 varsity basketball players through a structured self-assessment questionnaire evaluating seven internal and external training load constructs. Results revealed that all constructs were rated within the "Agree" range, indicating an overall "Adaptable" level of training load responsiveness. Internally, Perceived Exertion (mean = 3.43) and Sleep Quality and Duration (mean = 3.41) emerged as the strongest domains, while Training Impulse and Psychomotor Speed showed relatively lower adaptability. Externally, athletes scored highest in Role-Specific Skill Application (mean = 3.49) and Endurance Management (mean = 3.39), but lowest in Movement Efficiency (mean = 3.14) and Explosive Performance Monitoring (mean = 2.98). Significant differences were observed in several adaptability indicators based on years of playing experience and playing position, but not by year level or training hours. Notably, less experienced athletes showed higher adaptability in both internal and external domains, suggesting the influence of motivation and recent training exposure. The findings highlight the need for more individualized, position-specific, and experience-sensitive training programs. A targeted intervention plan addressing the lowest-rated constructs is recommended to optimize athlete performance, support recovery, and reduce injury risks. This study reinforces the importance of integrating internal and external load monitoring within sports training frameworks, guided by Adaptation Theory, to support holistic athlete development.

INTRODUCTION

Basketball is a physically demanding sport characterized by explosive actions, rapid changes in direction, and extended periods of moderate activity interspersed with high-intensity bursts (Rabita et al., 2021). To excel in this sport, athletes need to not only possess excellent technical skills but also maintain peak physical condition. Achieving and maintaining such conditions is contingent upon a well-structured training program and the ability to adapt to external and internal training loads. Understanding the adaptability of basketball athletes in terms of these training loads is crucial for optimizing performance while reducing the risk of injuries. By monitoring and analyzing the training loads of basketball athletes, coaches and trainers can tailor their programs to individual needs, ensuring that athletes are adequately prepared for the demands of the sport. This includes managing the balance between high-intensity training and recovery periods to prevent overtraining and minimize the risk of injury. Additionally, understanding how external factors such as travel, competition schedules, and environmental conditions can impact training loads is essential for optimizing performance and maintaining the overall well-being of basketball athletes.

Training load is a multifaceted concept encompassing both external and internal components (Impellizzeri et al., 2019). External training load pertains to the quantifiable aspects of training, such as the duration, intensity, and frequency of training sessions, as well as various performance metrics like power output, repetitions of movements, and distance covered (Gabbett, 2016; McLaren et al., 2018).

The ability of basketball athletes to adapt to these training loads is influenced by various factors, including their individual characteristics, training history, and the specific demands of the sport (Cormack et al., 2018; Scanlan et al., 2015). Sleep quality and duration, for instance, play a pivotal role in recovery and adaptation (Lastella et al., 2018).

While these factors individually contribute to the overall training load adaptability of basketball athletes, it is essential to comprehensively assess how they interplay in a dynamic training environment (Impellizzeri et al., 2019). Moreover, understanding how external and internal training loads affect athletes is vital for coaches, sports scientists, and sports medicine practitioners to develop effective training programs, monitor athlete readiness, and prevent injuries (McLaren et al., 2018).

This study aims to investigate the external and internal training load adaptability of basketball athletes in a selected university in Chengdu, China. By assessing factors such as sleep quality and duration, psychomotor speed, training impulse, perceived exertion, competition duration, competition frequency, positional data, power output, repetitions of movements, and distance covered, this research seeks to provide valuable insights into how these athletes respond to the demands of their sport. The findings of this study can inform the development of evidence-based training strategies, contributing to the performance and well-being of basketball athletes not only in the selected university but also in the broader context of basketball in China and beyond.

Background of the Study

In the People's Republic of China, basketball has witnessed exponential growth in popularity over the past few decades, making it one of the nation's most beloved sports. With its rapid ascent, the sport has attracted a considerable pool of talented young athletes aspiring to compete at the highest levels, from collegiate leagues to the international stage. However, excelling in the sport of basketball in China, as in other parts of the world, requires more than just raw talent; it necessitates rigorous training regimens and the ability to adapt to the diverse and demanding training loads imposed on athletes.

Basketball in China mirrors the global trends in the sport, characterized by the physically demanding nature of the game, comprising intense sprints, rapid changes in direction, and intermittent high-intensity actions (Rabita et al., 2021). To achieve and maintain peak performance in this challenging sport, athletes must not only hone their technical skills but also prioritize their physical conditioning. The crux of effective conditioning lies in comprehending and managing how athletes in China adapt to the multifaceted training loads inherent to their sport.

The concept of training load is complex, encompassing both external and internal components (Impellizzeri et al., 2019). External training load encompasses the quantifiable aspects of training, including training session duration, intensity, frequency, and performance metrics such as power output, repetitions of movements, and distance covered (Gabbett, 2016; McLaren et al., 2018).

Adaptability to these training loads is influenced by a multitude of factors in the Chinese basketball context. These factors encompass individual athlete characteristics, training backgrounds, and the unique demands that basketball places on athletes (Cormack et al., 2018). For instance, the quality and duration of sleep play a pivotal role in the recovery and adaptation of Chinese basketball athletes (Lastella et al., 2018). Moreover, psychomotor speed reflects the neuromuscular responsiveness of athletes, a characteristic that can significantly affect their performance on the court (Stojanović et al., 2018).

Given the intricate interplay of these factors, it is imperative to holistically assess how Chinese basketball athletes adapt within their dynamic training environments (Impellizzeri et al., 2019). Furthermore, comprehending how external and internal training loads affect athletes is of paramount importance for coaches, sports scientists, and sports medicine practitioners. Such insights are instrumental in crafting effective training programs, monitoring athlete readiness, and mitigating the risk of injuries, which is of particular significance in the highly competitive landscape of Chinese basketball (McLaren et al., 2018)

This research will investigate the external and internal training load adaptability of basketball athletes in a selected university in Chengdu, China, where the sport has witnessed substantial growth. By conducting a comprehensive assessment of factors such as sleep quality and duration, psychomotor speed, training impulse, perceived exertion, competition duration, competition frequency, positional data, power output, repetitions of movements, and distance covered, this study aspires to furnish invaluable insights into how these Chinese athletes respond to the multifaceted demands of basketball. The resultant findings hold the potential to contribute to the development of evidence-based training strategies, not only augmenting the performance and well-being of basketball athletes within the selected university but also furthering the understanding of basketball in the broader context of China and its role on the global stage.

Training Load

Training load in basketball refers to the physical and physiological stress placed on athletes during practice sessions and games to enhance their performance and physical conditioning. It is a critical aspect of basketball training that helps coaches and sports scientists optimize players' development and minimize the risk of injury (Jin et al., 2022).

Characteristics of training load in basketball encompass various factors, as observed in multiple studies. Firstly, the external load refers to the quantifiable aspects of training, such as distance covered, speed, and intensity during drills and games (Kutson et al., 2023; Hernández-Beltrán et al., 2023). This external load provides objective data that can be monitored to evaluate the players' physical condition and tactical positioning.

Additionally, the internal load involves physiological responses of players, including heart rate, heart rate variability index (TL HRV), and perceived exertion (RPE) (Jin et al., 2022; Kutson et al., 2023; Hou, 2022). Monitoring internal load helps assess the players' overall physiological stress and their readiness for training or competition. TL HRV, for instance, has been shown to be a valuable indicator for quantifying training load and differentiating between drills of varying intensity (Jin et al., 2022).

Training load may also vary during different phases of the season, as observed in studies during the COVID-19 pandemic (Kullik et al., 2022). Athletes adapt their training patterns in response to changes in their daily routines and external factors, such as lockdowns and restrictions, highlighting the importance of flexibility in training planning.

Furthermore, factors like agility, speed, endurance, and strength are essential components of training load in basketball (Lu & Yin, 2022). Periodic physical training programs can lead to improvements in these fitness indices, contributing to enhanced performance on the court.

Thus, training load in basketball encompasses both external and internal components, including measurable physical parameters and physiological responses. Monitoring and managing these aspects are vital for optimizing player development, ensuring their physical readiness, and preventing injuries, making it an essential component of basketball training. Coaches and sports scientists should use various methods, including heart rate monitoring and objective performance data, to tailor training load to individual athletes' needs and the demands of the sport.

Training load is a fundamental concept in sports science, encompassing various factors that influence the physical and physiological demands placed on athletes during training sessions and competitions. It plays a pivotal role in athlete development, performance optimization, and injury prevention across multiple sports (Coutts & Cormack, 2020).

The systematic review on training load in basketball has outlined several crucial parameters that shed light on the demands placed on athletes during both training and competition. First and foremost, the review highlights the significance of internal load quantifications, primarily relying on Heart Rate (HR) to gauge the physiological stress experienced by basketball players during training sessions and actual matches. Additionally, Session Rate of Perceived Exertion (sRPE), a subjective rating by players, multiplied by the duration of training, offers insights into the perceived effort during training.

In parallel, the review underscores the importance of external load quantifications, emphasizing the use of accelerometry and positional tracking cameras as prevalent tools for assessing the mechanical aspects of training and competition. These devices allow for the measurement of critical parameters such as total accelerations and decelerations, overall distance covered, and peak speeds achieved by players. Moreover, the review also recognizes the value of time-motion analysis, which offers a detailed breakdown of on-court movements during competition, including standing, jogging, running, sprinting, and jumping.

The review of Petway et al. (2020) delves into the specific demands of basketball competition, highlighting factors such as playing period, player position, skill level, geographical location, and gender as influential elements that shape the stress experienced by basketball athletes during matches. The concept of specific work-to-rest ratios is emphasized as a key determinant of the density of game-related activity during competition. Finally, the review delves into training demands, revealing that basketball training load parameters are multifaceted and contingent on factors such as training load quantification methods, player positions, perceived exertion levels, skill proficiency, and training experience. Internal load metrics, including HR and sRPE, are routinely employed to assess training intensity, while external load quantifications, utilizing accelerometers and positional tracking cameras, provide a comprehensive understanding of the mechanical demands imposed during training. Collectively, these parameters offer a holistic view of the physiological, mechanical, and technical demands placed on basketball players, regardless of their competition level, whether elite, sub-elite, or youth. Coaches and sports scientists can leverage this knowledge to tailor training strategies and effectively monitor player readiness, ensuring optimal performance and injury prevention in the dynamic world of basketball.

One key aspect of training load is its multifaceted nature, comprising both internal and external components (Bourdon et al., 2017). Internal load relates to the physiological responses and perceived effort experienced by athletes, including measures like heart rate, rate of perceived exertion (RPE), and hormonal responses (Impellizzeri et al., 2019). External load, on the other hand, involves objective metrics such as distance covered, sprinting, jumping, and accelerations, providing insights into the physical demands of training (Buchheit, 2014).

The dynamic nature of training load is another critical consideration (Halson, 2014). It varies over time based on the training phase, individual athlete characteristics, and specific training goals. For instance, during the preseason, training load may be elevated to enhance endurance and strength, while in the competition phase, the emphasis may shift towards skill development and tactical preparation (Impellizzeri et al., 2019).

Monitoring training load is essential for several reasons. Firstly, it aids coaches and sports scientists in designing effective training programs that prepare athletes adequately for competition while minimizing the risk of overtraining and injuries (Cormack et al., 2019). Secondly, it allows for the customization of training plans to accommodate variations in athlete fitness levels and recovery capacities (Gabbett, 2016). Lastly, it offers valuable insights into the relationship between training load, athlete performance, and adaptability (Windt et al., 2017).

Numerous studies have contributed to our understanding of training load in various sports. For instance, research by Impellizzeri et al. (2019) highlighted the significance of internal load markers such as heart rate variability in monitoring training responses. Additionally, a study by Gabbett et al. (2016) demonstrated the importance of workload management in preventing overuse injuries in cricket. Furthermore, in basketball, the work of Coyne et al. (2021) shed light on the relationships between different training load variables and elite performance.

In the realm of basketball training, researchers have recently turned their attention to the influence of pre-training athlete-reported conditions on subsequent training loads. This study, conducted by Sansone et al. (2023), focused on assessing how athlete-reported pre-training well-being and recovery impact external load intensity (EL·min-1), ratings of perceived exertion (RPE), and the efficiency index (EL·min-1:RPE) in youth basketball players. The study involved 15 youth basketball players aged 15.2±0.3 years. The findings of this study revealed a significant relationship between pre-training recovery and external load intensity. When players reported better pre-training recovery, external load intensity increased. Conversely, better pre-training conditions were associated with higher RPE scores and lower efficiency indexes. Specifically, RPE scores were higher when players reported better Total Quality Recovery (TQR), fatigue, muscle soreness, and stress scores, while training efficiency was lower when better TQR and sleep were reported. These results underscore the importance of monitoring and considering athlete-reported pre-training conditions when designing training programs for youth basketball players. Coaches and sports scientists can use this information to select appropriate athlete monitoring questionnaires and interpret training load data effectively.

Militello et al. (2021) conducted a study to investigate redox homeostasis and metabolic profiles in young female basketball players during the in-season training phase. The study included ten professional female basketball players who underwent five 2-hour training sessions per week, as well as ten sedentary control women for comparison. The study assessed various parameters, including antioxidant capacity, levels of reactive oxygen metabolites, and salivary cortisol. The results revealed that the antioxidant capacity (BAP value) was significantly higher in elite basketball players, while cortisol levels and oxidative species (d-ROM) were significantly lower in elite athletes compared to sedentary controls. These findings suggest that elite female basketball players exhibit better redox homeostasis and reduced stress levels during in-season training, which may contribute to their performance and overall well-being.

In a study published in Revista Brasileira De Medicina Do Esporte in 2022, Song Zhi-chen aimed to understand the effect of intense training on physiological indicators related to serum hormone levels in young basketball players. The study included 11 healthy young players without organic or genetic diseases who underwent an intense training protocol. Serum hormone indices, including creatine and blood urea levels, were analyzed before, 2, 4, and 24 hours after the training. The study found variations in creatine and blood urea levels after 24 hours, returning close to pre-workout levels. These findings suggest that intense basketball training can improve the anaerobic capacity of young players, and there is a correlation between changes in serum hormones and physical fitness.

Zhao et al. (2020) conducted a longitudinal study to evaluate the development of performance characteristics, physiological performance prerequisites, and body dimensions in Chinese male elite youth athletes from swimming and racket sports over a 2-year period. The study included 21 student-athletes, categorized into swimming and racket sports groups. The study used various physiological measurements, anthropometric parameters, and motor tests to assess performance development. Results indicated that seven out of eight diagnostic methods exhibited medium to high validity in discriminating performance development in the two sports groups. The study highlighted that performance characteristics are influenced by both inherent athletic disposition and sport-specific training regimens. This study provides insights into the importance of longitudinal testing to understand and optimize the performance of elite youth athletes in various sports.

Stepanyan et al. (2023) conducted a study to examine the functional state and cardiac activity regulation in athletes with disabilities, specifically wheelchair basketball players with musculoskeletal system damage. The study aimed to understand the effects of training load on the athletes' cardiac activity. The research involved measurements of anthropometric parameters, pulse, blood pressure, oxygen saturation, and heart rate variability (HRV). The study found that athletes with musculoskeletal system damage engaged in wheelchair basketball exhibited specific HRV patterns, high pulse rates, and significant pulse pressure changes. The study emphasized the need for tailored training and rehabilitation programs for athletes with disabilities. These findings shed light on the unique physiological responses of wheelchair basketball players to training load.

In their study, Espasa-Labrador et al. (2023) performed a comprehensive analysis to determine the techniques and factors employed in measuring internal load among female basketball athletes. The study sought to present a comprehensive summary of the existing research in this field. The results of their study indicated that the predominant techniques employed for measuring internal load were heart rate monitoring, rating of perceived effort, and session-RPE. Furthermore, the assessment of internal load often involved the use of factors such as training time, intensity, and volume. In summary, this research emphasizes the significance of precise analysis of internal load in female basketball athletes in order to optimize training regimens and improve overall performance.

The review covered various methods, including the rating of perceived exertion (RPE) method and sensor-based methods using heart rate (HR) as a primary metric. The findings showed that HR metrics, along with RPE, were the most commonly used methods. However, the lack of standardization and the use of multiple metrics resulted in heterogeneity among studies, making meaningful comparisons challenging.

In the field of basketball, understanding the relationship between training load and athlete performance is crucial. Romarate et al. (2021) conducted a study aiming to analyze the association between speed and acceleration variables measured during the bench press exercise and different percentages of one-repetition maximum (1RM) in wheelchair basketball (WB) players. Additionally, they investigated the impact of a 6-week strength training program on these athletes based on their functional impairments. Their findings revealed a significant association between %1RM and mean propulsive velocity (MPV) and maximum velocity (Vmax), both among all participants and within separate athlete groups. Furthermore, the strength training program led to improvements in 1RM, particularly in the IWBF (International Wheelchair Basketball Federation) 2.5 group (Romarate et al., 2021).

In another study, Antonelli et al. (2020) conducted a randomized clinical trial to assess the effects of inspiratory muscle training (IMT) combined with interval training on respiratory muscle strength, fatigue, aerobic physical performance (PP) in high-performance wheelchair basketball athletes. Their research aimed to enhance respiratory function and overall sports performance in this specific population (Antonelli et al., 2020).

Brown et al. (2023) conducted a study analyzing the external load during the in-season of women's collegiate basketball. By employing Global Positioning Systems sensors with accelerometers, they quantified practice and game external loads and assessed their relationship with basketball-specific performance metrics. The research involved different minute players and game quarters to explore the variations in external loads.

In a study by Brown et al. (2019), the impact of external training loads (eTL) during basketball practices on inter-limb asymmetries was evaluated. Collegiate basketball players underwent high and low eTL practices, and their inter-limb asymmetries were assessed using countermovement jumps. Although differences in eTL intensities were observed between practices, they did not result in immediate changes in lower inter-limb asymmetries (Brown et al., 2019).

Weiss et al. (2017) aimed to establish a relationship between acute chronic workload ratios and lower-extremity overuse injuries in professional basketball players during a competitive season. Their research indicated that workload ratios between 1 to 1.49 were associated with fewer injuries compared to very low, low, or high workload ratios (Weiss et al., 2017).

Willberg et al. (2022) conducted a study comparing the load structures between classic basketball and 3 × 3 basketball. They found significant differences in game duration, intensity, and physical demands between the two disciplines, providing insights into the unique challenges posed by 3 × 3 basketball (Willberg et al., 2022).

Clemente et al. (2019) explored the perceived training load and wellness status in professional basketball players during regular and congested weeks. Their findings highlighted the importance of tapering phases before matches to improve athletes' wellness and prevent overtraining (Clemente et al., 2019). Furthermore, Clemente et al. (2020) investigated the relationships between internal training load (session-RPE) and wellness status (DOMS, stress, fatigue, and sleep quality) on both daily and weekly bases over a professional basketball season. Their results indicated that DOMS and fatigue were more associated with session-RPE than stress and sleep quality in professional basketball players (Clemente et al., 2020).

Julio Cesar and Barbosa Menezes (2015) monitored the competitive internal load in school sub-17 basketball players during three consecutive matches using the session-rating of perceived exertion (session-RPE) method. They observed progressive increases in competitive internal load due to consecutive games, demonstrating the utility of session-RPE for monitoring training load in this age category.

Training loads in basketball are crucial for optimizing athlete performance and minimizing injury risks. External and internal training loads are essential for athletes to develop adaptive responses and improve physical abilities. Monitoring training loads involves evaluating external and internal factors such as duration, frequency, type, positional data, power output, speed, acceleration, neuromuscular function, repetitions, and distance covered. In basketball, smaller weekly fluctuations in training loads are associated with improved performance and lower injury risks. Gradual and controlled increases in training loads are protective against injuries, while sudden, excessive load increases can elevate injury risks. Monitoring can be done through ecological or technological means, with ecological methods providing reliable data and coaching staff involvement. Training-load monitoring applies across all levels of sports practice, including elite teams, subelite teams, and young players, with a focus on adolescents due to the relationship between high training volumes, injury rates, and sports dropout. (Piedra, et al., 2021)

External and Internal Training Load Adaptability in Basketball Athletes

In the domain of sports science, the concepts of external and internal training load (TL) have become fundamental in understanding athlete adaptation and optimizing performance. External TL refers to quantifiable training variables such as intensity, duration, frequency, and movement-based metrics, while internal TL encompasses physiological and psychological responses, including heart rate variability, perceived exertion, and hormonal fluctuations (Coyne et al., 2021; Fields et al., 2021). The dynamic interplay between these two factors plays a crucial role in managing athletes' workload, mitigating fatigue, and preventing injuries, particularly in high-intensity sports like basketball.

Recent studies emphasize the necessity of systematic training load monitoring to enhance athletic performance and minimize injury risks (Hernández-Beltrán et al., 2023). In professional basketball, the quantification of TL has been shown to provide insights into players' physical conditioning during both training and competition, highlighting the variability in load demands based on player position and game situation (Hernández-Beltrán, Escudero-Tena, & Ibáñez Godoy, 2023). The results suggest that centers experience the highest internal load during preseason, indicating the need for individualized training programs tailored to positional demands.

The bidirectional relationship between external and internal TL is particularly evident in the context of fatigue management. Fields et al. (2021) found that while external TL decreased over the course of a preseason training cycle, hormonal responses such as cortisol and testosterone fluctuations indicated delayed fatigue patterns, suggesting that internal load adaptations may have a lagged response to external stimuli. Similarly, Ferreira et al. (2024) demonstrated that intensified training loads in young soccer players led to improved sleep parameters post-training, reinforcing the importance of recovery strategies in response to high TL.

Furthermore, discrepancies between internal and external TL measurements highlight the complexity of monitoring athlete adaptation. Kårström, Swarén, and Björklund (2024) found that internal TL markers such as heart rate-based training impulse (TRIMP) did not effectively differentiate between high- and low-intensity training sessions in biathlon athletes, suggesting that incorporating additional external TL metrics could enhance training prescription. This aligns with the findings of Honório et al. (2023), who identified significant associations between lower limb power and fatigue indices, indicating that younger athletes may require different training adjustments compared to their older counterparts.

In basketball, adapting TL is essential to optimizing in-season performance. Coyne et al. (2021) found that manipulating training load within the three weeks leading up to a competition was significantly associated with improved performance among elite female basketball players. Notably, changes in training efficiency index correlated with successful game performances, emphasizing the importance of periodization in TL management. Similarly, Sciortino, Cumbo, and Şenel (2023) observed that coaches' predicted training loads closely correlated with players' perceived exertion, reinforcing the necessity of aligning coaching expectations with athletes' subjective experiences.

The interplay of TL components also influences neuromuscular fatigue and overall well-being. In elite volleyball athletes, Rebelo et al. (2023) found that training monotony was negatively associated with jump performance, sleep quality, and fatigue levels, underscoring the necessity of load variation to maintain peak athletic output. This aligns with the findings of Lin et al. (2024), who quantified TL fluctuations throughout a competitive season and emphasized the importance of adaptive load management to sustain performance.

The importance of individualized TL prescription extends beyond basketball and is relevant across multiple high-intensity sports. Hernández-Beltrán et al. (2023) analyzed TL in wheelchair basketball, revealing that players with higher functional classifications experienced greater TL variability. Their findings suggest that personalized training regimens can optimize performance while minimizing injury risks. Similarly, Dudley et al.

(2023) conducted a systematic review synthesizing TL monitoring methods in adolescent athletes, concluding that resistance training volume was a critical factor in strength development and injury prevention.

In conclusion, external and internal TL adaptability is crucial for optimizing athlete performance, managing fatigue, and preventing injuries in basketball and other high-intensity sports. The integration of TL monitoring into training programs enables coaches and sports scientists to tailor load management strategies to individual athlete needs, ensuring both short-term success and long-term athletic development. Future research should continue to explore multivariate TL monitoring techniques to refine training periodization models and enhance athlete well-being.

THEORETICAL FRAMEWORK

In the field of sports science and athlete preparation, Adaptation Theory serves as a foundational principle that explains how athletes undergo physiological and psychological modifications in response to structured training stimuli. The interaction between external training load (ETL) and internal training load (ITL) is a key aspect of this adaptation process, influencing performance optimization, recovery, and injury prevention in basketball and other high-intensity sports (Coyne et al., 2021; Fields et al., 2021).

Adaptation Theory postulates that athletes progressively adapt to increasing workloads, provided that training stimuli are appropriately structured to avoid excessive fatigue and overtraining (Hernández-Beltrán, Escudero-Tena, & Ibáñez Godoy, 2023). This adaptation is mediated through the interaction of external and internal training loads. ETL encompasses quantifiable aspects such as movement repetitions, intensity, and volume, whereas ITL reflects physiological and psychological responses, including heart rate variability, hormonal changes, and perceived exertion levels (Fields et al., 2021; Kårström, Swarén, & Björklund, 2024). The balance between ETL and ITL is crucial in determining the effectiveness of training programs and in preventing maladaptive responses such as burnout or injury.

External training load provides an objective measure of the work performed by an athlete. Metrics such as distance covered, acceleration and deceleration, and movement intensity serve as direct indicators of training demands (Hernández-Beltrán et al., 2023). In basketball, ETL varies based on positional demands and game intensity—centers, for example, exhibit higher loads due to their involvement in more physically demanding activities such as rebounding and post-play (Hernández-Beltrán et al., 2023). Honório et al. (2023) further emphasized the need to adjust ETL across different age groups, noting that younger athletes exhibit varying fatigue indices based on their lower limb power and shooting efficiency.

Internal training load measures the athlete's physiological response to external stimuli. It includes variables such as heart rate, cortisol and testosterone levels, and subjective measures like rating of perceived exertion (RPE) (Coyne et al., 2021; Fields et al., 2021). ITL is influenced by factors such as training intensity, recovery, and accumulated fatigue, making it a key determinant of an athlete's readiness for competition. In professional basketball, monitoring ITL enables coaches to fine-tune training intensity to optimize performance while avoiding excessive physiological stress (Hernández-Beltrán et al., 2023).

The dynamic relationship between ETL and ITL determines an athlete's ability to recover and adapt to training stimuli. Studies show that while ETL provides a direct physical challenge, ITL governs the body's ability to absorb and respond to that challenge (Fields et al., 2021; Kårström et al., 2024). The training efficiency index, a measure that considers both loads, has been found to significantly correlate with successful game performance in elite female basketball players (Coyne et al., 2021). Similarly, research in soccer and biathlon has highlighted discrepancies in ETL and ITL measurements, demonstrating the need for a multi-dimensional monitoring approach that accounts for physiological responses alongside objective workload tracking (Kårström et al., 2024).

Conceptual Framework

In the context of this study focusing on basketball athletes in China, the intricate interplay between external and internal training loads takes center stage. The relationship between these two dimensions becomes the crux of

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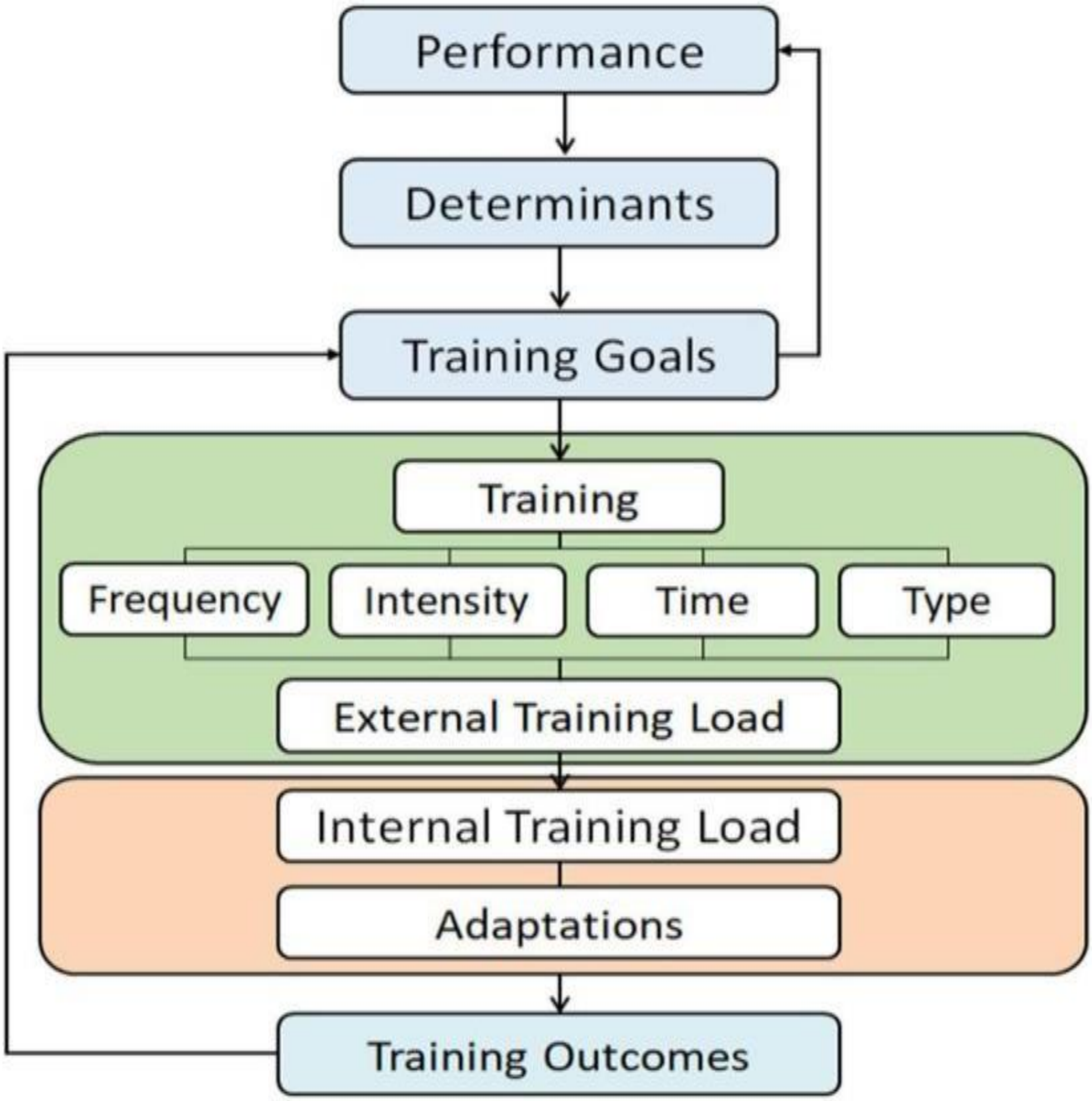
optimizing performance while mitigating the risks associated with overtraining and injuries. External Training Load, encompassing parameters such as session duration, intensity, frequency, and various performance metrics, serves as the tangible, objective facets of the training process, providing coaches and sports scientists with measurable data. It acts as the catalyst, instigating a series of physiological and psychological responses within the athlete's body and mind. These responses, constituting the internal training load, represent the adaptive mechanisms that enable the athlete to cope with and excel in the demanding realm of basketball. The harmony between external and internal training loads symbolizes the athlete's ability to effectively harness external stimuli, transforming them into enhanced physical capabilities, mental resilience, and optimized performance. This exploration within the framework of Adaptation Theory is pivotal not only for the athletes themselves but also informs coaching methodologies, sports science practices, and injury prevention strategies within the realm of basketball in China. It is articulated using the following:



(Source: Impellizzeri et al., 2019))

Thus, the conceptual framework for this research study hinges on the premise that student-athletes' adaptability to external training loads plays a pivotal role in their performance and overall well-being within the context of basketball at a selected university in Chengdu, China. The study posits that the external training load adaptability of student-athletes is influenced by various factors encompassing their academic year, experience in competitive basketball, playing position, and weekly training hours.

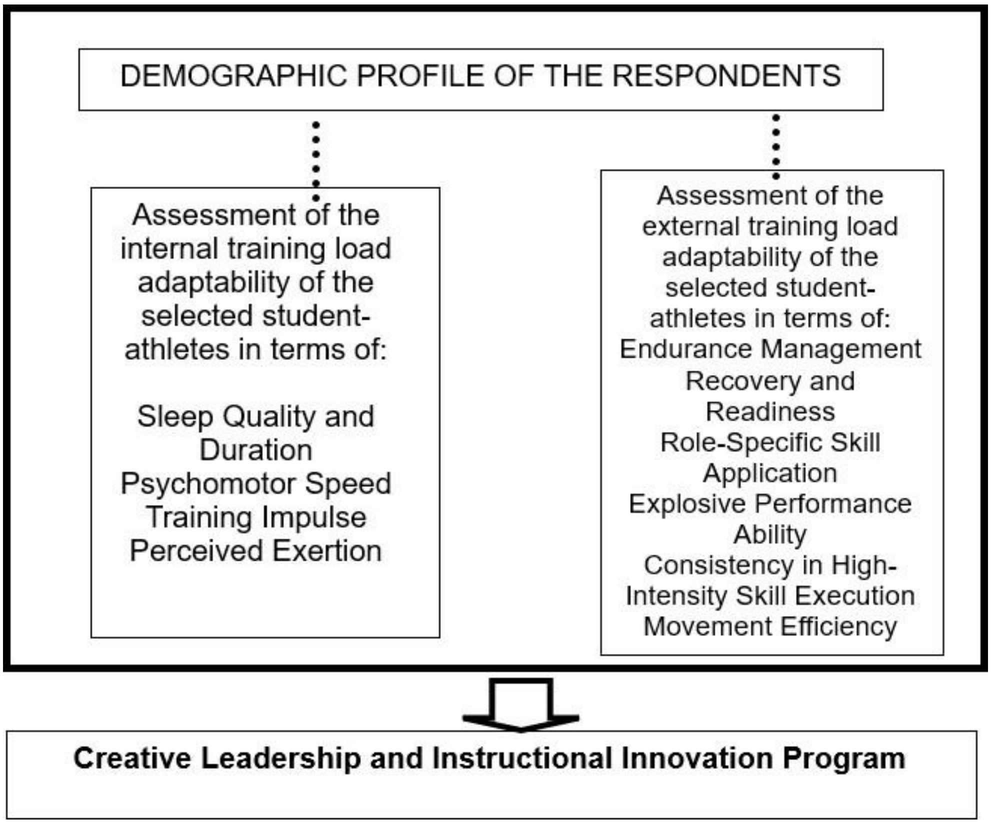


Figure 1. Research Paradigm

This study was anchored on the Adaptation Theory, which posited thAt athletes underwent continuous physiological and psychological adaptations in response to structured training stimuli. The adaptability of internal and external training loads played a crucial role in shaping athlete performance, recovery, and injury prevention. This framework provided a structured approach to analyzing how basketball student-athletes at a selected university in Chengdu, China adjusted to training demands and how their profiles influenced these adaptations.

The core of this study was the interaction between External Training Load (ETL) and Internal Training Load (ITL). ETL referred to quantifiable physical demands imposed on athletes during training and competition, including Endurance Management, Recovery and Readiness, Role-Specific Skill Application, Explosive Performance Ability, Consistency in High-Intensity Skill Execution, and Movement Efficiency. Those factors constituted the external workload that directly influenced training effectiveness. Conversely, ITL represented the athlete's physiological and psychological responses to training, encompassing sleep quality and duration, psychomotor speed, training impulse, and perceived exertion. Those responses reflected the athlete’s capacity to recover, adapt, and sustain performance levels over time.

The study aimed to describe, compare, and analyze the adaptability of basketball athletes to training loads. The descriptive component examined the profile of respondents in terms of their academic year, competitive basketball experience, playing position, and average weekly training hours, which served as possible determinants of training adaptability. The comparative analysis explored whether there were significant differences in ITL and ETL adaptability based on athlete profiles, helping to determine if experience, training volume, or position-specific roles affected load management. Lastly, the correlational analysis assessed whether a significant relationship existed between ITL and ETL, providing insights into how external stimuli directly influenced physiological and psychological responses in basketball athletes.

Through this framework, the study contributed to the development of an evidence-based training plan that aligned with the specific needs of basketball student-athletes. By identifying how players responded to training based on their workload and physiological adaptation, the study provided practical recommendations for individualized and team-based training that enhanced performance, recovery, and injury prevention. Ultimately, this conceptual framework guided basketball coaches, trainers, and sports scientists in optimizing training methodologies within university-level basketball programs.

Statement of the Problem

This research study aimed to assess the internal and external training load adaptability of selected student-athletes in the context of basketball in a selected university in Chengdu, China. Additionally, the study aimed to propose a tailored training plan based on the assessment results to optimize the performance and well-being of the student-athletes. It answered the following questions:

What is the profile of the respondents in terms of:

1. Year level;
2. Year of playing basketball competitively;
3. Playing Position;
4. Average weekly training hours?

What is the assessment of the internal training load adaptability of the selected student-athletes in terms of:

1. Sleep Quality and Duration;
2. Psychomotor Speed:
3. Training Impulse;
4. Perceived Exertion?

Is there a significant difference in the assessment of the internal training load adaptability of the selected student-athletes when profile is used a test factor?

What is the assessment of the external training load adaptability of the selected student-athletes in terms of:

1. Endurance Management
2. Recovery and Readiness
3. Role-Specific Skill Application
4. Explosive Performance Ability
5. Consistency in High-Intensity Skill Execution
6. Movement Efficiency?

Is there a significant difference in the assessment of the external training load adaptability of the selected student-athletes when profile is used a test factor?

Based on the results of the study, what basketball training plan can be proposed for the student-athletes?

Hypothesis

There is no significant difference in the assessment of the internal training load adaptability of the selected student-athletes when profile is used a test factor.

There is no significant difference in the assessment of the external training load adaptability of the selected student-athletes when profile is used a test factor.

Significance of the Study

The significance of the study on the external and internal training load adaptability of basketball athletes in a selected university in China is multifold, and its beneficiaries include various stakeholders in the field of sports and sports science:

Athletes and Coaches. The study will provide evidence-based recommendations for individualized training plans, helping athletes reach their full potential while minimizing the risk of overtraining and injuries.

Sports Scientists and Researchers. The research will contribute to the existing body of knowledge on training load adaptability in basketball, furthering our understanding of the sport's unique demands. This can lead to the development of more effective training methodologies and injury prevention strategies.

University Sports Programs: The study's findings can inform the development of evidence-based training programs within university sports departments. This can enhance the overall competitiveness of the university's sports teams and promote a culture of athlete well-being.

Sports Medicine Practitioners: Understanding how training loads affect athletes' internal and external factors will assist in injury prevention and rehabilitation. Sports medicine practitioners can tailor their interventions based on the study's recommendations.

National and Regional Sports Organizations: The study can serve as a reference for developing guidelines and standards for training load management in basketball. This can benefit athletes at all levels, from university to professional, leading to improved performance and fewer injuries.

Future Athletes: The study's outcomes can guide future athletes in understanding the importance of training load management, helping them make informed decisions about their training regimens and long-term athletic careers.

Academic Community: The research contributes to the academic discourse on sports science and exercise physiology. It provides a practical application of scientific principles in sports, which can serve as an educational resource for students pursuing careers in sports-related fields.

Future Researchers. This study will provide a strong foundation for future research in the field of sports science, exercise physiology, and athlete conditioning. Researchers can build upon the findings to explore new methods of training load monitoring, the impact of psychological factors on internal load, and the long-term effects of training adaptation on athletic careers. Additionally, future studies can expand the scope to different levels of competition, sports disciplines, and diverse athletic populations to generalize findings across various sporting contexts.

Scope and Delimitation

This research study's scope focused on assessing the external and internal training load adaptability of student-athletes who participated in basketball programs within a selected university in Chengdu, China. The study employed a quantitative comparative research design to examine respondents who were actively engaged in the university's basketball program. Those respondents represented a diverse group, spanning various academic years, levels of competitive basketball experience, playing positions, and weekly training hours.

The research design chosen for that study was quantitative comparative correlational. This approach involved the collection of numerical data from the selected student-athletes, followed by a systematic comparison and analysis of this data to uncover patterns and differences in terms of profile. The respondents who participated in this research study were drawn from the pool of student-athletes who were actively involved in the university's basketball program. This group exhibited a diverse range of characteristics, including varying academic years, years of competitive basketball experience, playing positions within the team, and average weekly training hours. The selection of this respondent pool ensured the representation of the broader population of basketball players within the university.

The study's scope was constrained by the availability and willingness of participants to engage. While efforts were made to secure a representative sample, practical constraints impacted the final sample size.

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The study's findings were context-specific, primarily applicable to the chosen university in Chengdu, China. Generalizability to other basketball programs or regions required caution. The accuracy of collected data was influenced by respondents' willingness to provide accurate and truthful responses. Factors such as recall bias affected the validity of self-reported data. The research operated within the framework of the university's basketball program schedule, subject to external influences like academic commitments and unforeseen events.

Definition of Terms

The following terms were defined operationally:

Consistency in High-Intensity Skill Execution refers to ability to repeatedly and reliably perform demanding actions during high-pressure moments in games.

Endurance Management is the athlete's ability to maintain skillful performance throughout the full duration of a game or training session.

Explosive Performance Ability pertains to the athlete's capability to perform powerful movements like sprints, jumps, and quick changes in direction.

External Training Load Adaptability in this study is the ability of an athlete to cope with and adjust to the physical demands measured by objective data during training or competition, such as distance covered, speed, movement intensity, and position-specific workload.

Internal Training Load Adaptability is the ability of an athlete to respond and adjust to the physical and psychological demands of training or competition based on internal body signals such as heart rate, perceived effort, fatigue, and recovery factors like sleep and stress levels.

Movement Efficiency is how effectively and economically an athlete moves during play, using the least energy for the most impact.

Perceived Exertion refers to the athlete's own rating of how hard a workout or game feels, based on effort, fatigue, and strain.

Psychomotor Speed pertains to the athlete's ability to quickly process information and respond with physical movement (e.g., reaction time, hand-eye coordination).

Recovery and Readiness is the ability to regain energy and prepare the body and mind for the next physical effort after training or competition.

Role-Specific Skill Application is how well the athlete performs the physical skills required by their position under varying levels of exertion.

Sleep Quality and Duration is the amount and restfulness of an athlete's sleep, which affects recovery and readiness to train or compete.

Training Impulse refers to the measure of how hard and how long an athlete trains, reflecting the overall internal training stress.

METHODOLOGY

Design

This study employed a descriptive-comparative research design to assess the internal and external training load adaptability of basketball student-athletes in a selected university in Chengdu, China. This research design is appropriate as it allows for a systematic assessment of training load adaptability, an analysis of differences based on athlete profiles, and an evaluation of the relationship between internal and external training loads. By utilizing this approach, the study provided evidence-based insights that informed the development of a tailored basketball training program.

The descriptive component of the study focused on profiling the selected student-athletes according to their academic year, years of competitive basketball experience, playing position, and average weekly training hours. This established a baseline understanding of the respondents and their training background. Descriptive analysis was crucial as it provided foundational data that helped interpret the variations in training load adaptability among athletes.
The comparative component sought to determine whether there were significant differences in the internal and external training load adaptability of student-athletes when grouped according to their profile variables. Since different playing positions and experience levels influenced an athlete's ability to adapt to training loads, this comparison helped identify trends and disparities that guided training adjustments. Additionally, understanding how the academic year or training experience impacted load adaptability contributed to refining athlete development strategies within the university's sports program.

Locale of the Study

The locale of the study was Chengdu Sport University, which is one of the oldest sports colleges in China. It was formerly one of the six sports colleges directly under the General Administration of Sport of China and is now a co-built institution by the Sichuan Provincial People's Government and the General Administration of Sport of China.

The university adheres to the design concept of "integration and sharing, openness and interaction, ecological concentration, and cultural inheritance", and has built a smart, harmonious and beautiful campus covering an area of over 1,500 mu and with a construction area of about 780,000 square meters, providing strong support for talent cultivation and environmental education. Currently, the university has over 10,000 full-time undergraduate students and more than 1,800 postgraduate students.

During its long-term development, the university has adhered to the socialist direction of running the school, clearly defined its mission as "building a world-class sports university with distinct characteristics and multi-disciplinary integrated development", and formed the educational philosophy of "taking the undergraduate education as the foundation, consolidating the basic knowledge, emphasizing practical application, highlighting advantages, taking uniqueness as the wing, and creating brands, prioritizing teachers, and laying a solid foundation". It adheres to the educational approach of "shaping the school style with educational traditions, gathering vitality through reform and innovation, expanding influence through diversified services, and achieving new heights through connotative development", and has set the goal of cultivating high-quality applied talents with "one major and multiple skills". It has refined the distinct educational characteristics of "taking sports as the foundation, integrating sports and medicine, combining sports and literature, and incorporating sports and art", and is striving to cultivate new era talents capable of shouldering the great responsibility of national rejuvenation.

Population, Sample, and Sampling Technique

In this study, the sampling technique employed was total enumeration. Total enumeration meant that the entire population of interest, which, in this case, consisted of all the basketball players in Chengdu, China, was included as participants in the research. This approach was chosen for several reasons. Firstly, total enumeration ensured that every eligible individual within the population was considered, leaving no room for sampling bias or uncertainty about the representation of the sample. The study aimed to comprehensively assess the external training load adaptability of all basketball players in the university, and including the entire population aligned with the research objectives.

Secondly, it had been feasible and practical in that context. The population size of basketball players within the university was likely manageable within the constraints of the study's resources and timeframe. As a result, it was both efficient and practical to include all eligible participants, minimizing the potential for selection bias.

Moreover, it allowed for a more detailed and comprehensive analysis of the population's characteristics and external training load adaptability. It provided a holistic view of the entire group of interest, including variations in academic year, years of playing basketball competitively, playing positions, and weekly training hours. Hence, the research gathered 60 basketball athletes as participants.

Instrument

The researcher-made instrument that was employed in this research study was designed to assess the internal and external training load adaptability of selected student-athletes engaged in basketball at Chengdu Sport University. Comprising three distinct parts, this comprehensive instrument aimed to collect pertinent data for a holistic assessment of the student-athletes' training load adaptability.

The initial segment of the instrument focused on gathering fundamental information about the student-athletes. Participants were required to provide details concerning their academic year, the number of years they had actively participated in competitive basketball, their specific playing position within the team, and the average weekly duration they dedicated to training sessions.

Part two delved into the student-athletes' responses to various external training load factors. This section encompassed their subjective assessments of sleep quality and duration, their psychomotor speed, their training impulse, and their perceived exertion during training sessions. Participants used a rating scale ranging from "Strongly Disagree" (4) to "Strongly Agree" (1) to indicate their agreement with each statement.

The third component of the instrument concentrates on specific competition-related metrics that can significantly influence how student-athletes adapt to internal training loads. Parameters such as competition duration, competition frequency, positional data, power output, repetitions of movements, and distance covered during competitive matches were measured.

To ensure the reliability and validity of the instrument, content validity was established through expert consultations in the field of sports science and training load monitoring. A pilot test was conducted with a subgroup of the target population to evaluate the instrument's clarity and reliability.

Data Gathering Procedure

There was an ethical and methodical approach to collecting data. Appropriate permits and consents were requested from the authorities of the selected educational setting. This initial step was crucial to ensure that the research was authorized and aligned with the established organizational policies and regulatory requirements. Upon obtaining the required permissions, participants were selected.

Before administering the research instrument (which included questionnaires, surveys, or other data collection methods), each potential participant was presented with a consent form. This document provided comprehensive information about the study's purpose, the extent of their involvement, the expected duration of participation, and the guarantees of confidentiality and anonymity. Only after obtaining written consent from the participants did the research instrument get distributed.

Participants were given a specified timeframe within which to complete the research instrument, and gentle reminders were sent as the deadline approached. It was emphasized that participation was entirely voluntary, and individuals could choose to withdraw from the study at any point without facing any adverse consequences.

Once all research instruments were collected, a thorough process of data organization and preparation for analysis was carried out. Any incomplete or improperly filled instruments were addressed, either through their exclusion from the analysis or by seeking clarification, depending on the nature of the discrepancy.

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Statistical Analysis of Data

The collected data underwent a comprehensive statistical analysis to derive meaningful insights and draw valid conclusions regarding the external training load adaptability of the selected student-athletes in the context of basketball.

The analysis commenced with the initial examination of descriptive statistics to provide an overview of the respondents' profiles. This included the calculation of measures such as means, standard deviations, and frequency distributions for variables such as academic year, years of competitive basketball experience, playing position, and average weekly training hours.

Following this, inferential statistical techniques were employed to assess the relationships and differences within the data. Particular attention was given to the external training load adaptability constructs, including sleep quality and duration, psychomotor speed, training impulse, and perceived exertion. Hypothesis testing, utilizing appropriate statistical tests such as t-tests and analysis of variance (ANOVA), was conducted to determine if significant differences existed among various subgroups of the student-athletes.

Moreover, the statistical analysis extended to the examination of external training load factors related to competition, such as competition duration, competition frequency, positional data, power output, repetitions of movements, and distance covered. Multivariate statistical techniques, including regression analysis and correlation analysis, were applied to investigate the interplay between these variables and their impact on training load adaptability.

Throughout the analysis, the significance level was set to a predetermined value (e.g., $\alpha = 0.05$) to assess the statistical significance of the findings. The results were interpreted in the context of the research objectives and research questions, providing valuable insights into how these student-athletes responded to external training loads in the sport of basketball.

Ethical Consideration

Paramount importance was given to ethical considerations to ensure the credibility and integrity of the study. Firstly, permissions were diligently sought from relevant authorities and organizations before commencing the data collection process. Upon receiving the necessary approvals, the potential participants were informed about the purpose, objectives, and implications of the research. Consent forms were presented, elaborating on the voluntary nature of participation and the rights of the participants, ensuring that they had a comprehensive understanding of their involvement. They were also assured that they could withdraw from the study at any point without facing any repercussions.

Confidentiality and anonymity were strictly maintained, ensuring that the personal and professional identities of the respondents were protected. Data was stored securely, with access restricted solely to the research team. Any information shared was used strictly for research purposes, and any publications or presentations derived from the research presented aggregated data, making it impossible to trace back to individual participants.

Furthermore, findings were communicated transparently, ensuring that results were not misrepresented or manipulated. Respect for participants, their views, and their time remained central throughout the research process. Any potential conflicts of interest were declared upfront to avoid any biases in the research process. By adhering to those ethical guidelines, the study aimed to maintain the highest standards of research integrity and ensured the well-being and rights of all involved parties.

RESULTS AND DISCUSSION

This section presents the analysis and interpretation of data gathered in the study. It involves the examination and interpretation of the collected data to uncover patterns, trends, and insights related to the research objectives and questions. It focuses on presenting and analyzing the data in a systematic and organized manner, using appropriate statistical techniques and qualitative methods as applicable.

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Table. Profile of Respondents

Variable	Category	Frequency	Percentage
Year Level	1st Year	20	33.3%
	2nd Year	9	15.0%
	3rd Year	19	31.7%
	4th Year	12	20.0%
	TOTAL	60	100.0%
Year of Playing Basketball Competitively	Less than 1 year 1–	24	40.0%
	2 years	15	25.0%
	3–above	21	35.0%
	TOTAL	60	100.0%
Playing Position	Point Guard	14	23.3%
	Shooting Guard	13	21.7%
	Small Forward	13	21.7%
	Power Forward	11	18.3%
	Center	9	15.0%
	TOTAL	60	100.0%
Average Weekly Training Hours	Less than 5 hours	18	30.0%
	5–7 hours	15	25.0%
	8–above	27	45.0%
	TOTAL	60	100.0%

The profile of respondents in this study reveals a diverse distribution across various demographic and athletic variables, offering a comprehensive view of the participants' backgrounds and experiences. In terms of academic standing, the majority of the respondents are in their 1st year (33.3%) and 3rd year (31.7%) of college, followed by 4th-year students at 20.0% and a smaller portion from the 2nd year (15.0%). This suggests that a significant portion of the sample is composed of students in the early and mid-stages of their academic journey, which may influence their levels of commitment, experience, and available time for athletic participation.

When considering their competitive basketball experience, 40.0% of the respondents have been playing for less than a year, indicating a large group of relatively new players. Meanwhile, 35.0% have been involved in competitive play for over three years, and 25.0% have between one to two years of experience. This distribution suggests a mix of novice and experienced athletes, which could impact their performance, skill development, and perspectives on training.

The respondents are also fairly evenly distributed across different playing positions, though point guards make up the highest proportion at 23.3%, followed closely by shooting guards and small forwards, each accounting for 21.7%. Power forwards (18.3%) and centers (15.0%) constitute smaller but still substantial groups. This variety in positions implies that the study captured insights from athletes with diverse roles on the court, which may reflect differing physical demands, training focuses, and gameplay experiences.

Lastly, regarding training commitment, 45.0% of the respondents train for eight or more hours per week, showing a strong dedication among nearly half of the sample. In contrast, 30.0% train for less than five hours weekly, and 25.0% fall within the five to seven-hour range. This variation in training intensity might correlate with athletic performance, skill acquisition, and the players' competitive edge, which are valuable dimensions to consider in the broader context of the study.

Table 2. Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Sleep Quality and Duration

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
1. I consistently get enough sleep to feel refreshed and alert for training sessions.	2.97	.882	Agree	Adaptable	6
2. I have a regular sleep schedule, going to bed and waking up at the same times each day.	2.95	.832	Agree	Adaptable	7
3. I struggle with falling asleep or staying asleep during the night.	3.37	.843	Agree	Adaptable	5
4. I often feel fatigued and drowsy during the day due to insufficient sleep.	3.70	.591	Strongly Agree	Highly Adaptable	2
5. My sleep quality has a noticeable impact on my athletic performance.	3.63	.637	Strongly Agree	Highly Adaptable	3
6. I prioritize getting a full night's sleep, especially before important training sessions or competitions.	3.48	.676	Agree	Adaptable	4
7. I use relaxation techniques or	3.80	.403	Strongly Agree	Highly Adaptable	1

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strategies to improve my sleep quality.					
Overall Mean	3.41	.292	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

The assessment of internal training load adaptability in terms of sleep quality and duration among the selected student-athletes reveals a generally positive profile, with an overall weighted mean of 3.41 and a standard deviation of 0.292. This overall mean falls within the "Agree" range, indicating that, as a group, the respondents demonstrate an "Adaptable" level of internal training load response related to sleep. This suggests that student-athletes possess a moderate capacity to manage their sleep habits in a way that supports their training needs, though there remains room for enhancement.

Notably, the highest-rated indicator is the use of relaxation techniques or strategies to improve sleep quality, with a weighted mean of 3.80 and a remarkably low standard deviation of 0.403. This strong agreement, categorized as "Highly Adaptable," reflects a shared and consistent effort among athletes to actively engage in practices that promote better sleep. The consistency in this response may indicate institutional support or personal awareness about the role of sleep in performance optimization.

Conversely, the lowest mean score is observed in the statement, "I have a regular sleep schedule, going to bed and waking up at the same times each day," which scored 2.95 with a standard deviation of 0.832. Although this still falls under the "Agree" and "Adaptable" interpretation, it suggests a relative inconsistency in maintaining a structured sleep schedule, which could affect overall sleep quality and, by extension, athletic readiness and recovery.

Interestingly, while some athletes acknowledge experiencing challenges such as struggling with sleep onset or maintenance (mean = 3.37), others report feeling daytime fatigue due to insufficient sleep (mean = 3.70). These results, both within the "Adaptable" and "Highly Adaptable" range respectively, imply a certain tension: athletes are aware of their fatigue and the consequences of poor sleep, yet they may not always manage to implement preventive measures effectively or maintain consistent sleep patterns.

Furthermore, the item stating that sleep quality noticeably impacts athletic performance received a high rating of 3.63, reinforcing the idea that student-athletes recognize the link between rest and their physical output. The proactive prioritization of sleep before critical training sessions or competitions also scored relatively high (mean = 3.48), again affirming a general awareness and effort to manage internal training loads responsibly.

The highest score in the use of relaxation techniques (3.80) aligns with findings from Ferreira et al. (2024)**,** who demonstrated that recovery and sleep quality improve post-intense training loads. According to Adaptation Theory, sleep plays a critical role in facilitating recovery from internal stressors such as hormonal fluctuations and accumulated fatigue. The moderately low score in maintaining a consistent sleep schedule (2.95) suggests an area for improvement, emphasizing the need for structured sleep hygiene education to enhance internal load recovery processes.

In summary, the findings illustrate a generally adaptable sleep-related behavior among the student-athletes, with strengths in the use of sleep-enhancing strategies and a strong awareness of sleep's role in performance. However, the variability in maintaining regular sleep schedules and the presence of sleep-related fatigue highlight areas for potential intervention. Promoting more structured sleep routines and addressing sleep disturbances could further enhance the athletes' adaptability and overall performance.

Table 3. Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Psychomotor Speed

Indicator	Weighted Mean	Standard Deviation	Qualitative Description	Verbal Interpretation	Rank
1. My reaction time and quick decision-making skills have improved with my training.	3.32	.833	Agree	Adaptable	3
2. I feel mentally sharp and focused during training sessions and competitions.	3.43	.789	Agree	Adaptable	2
3. I occasionally struggle with processing information quickly during fast-paced situations.	3.50	.567	Agree	Adaptable	1
4. My psychomotor speed is a crucial factor in my performance as an athlete.	2.98	.813	Agree	Adaptable	7
5. I regularly engage in cognitive exercises or drills to enhance my psychomotor skills.	3.23	.831	Agree	Adaptable	4
6. I believe that my psychomotor skills are an asset to my overall performance.	3.18	.813	Agree	Adaptable	5
7. I am open to training methods that can further enhance my psychomotor speed.	3.02	.854	Agree	Adaptable	6
Overall Mean	3.23	.28	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As presented in Table 3, the assessment of internal training load adaptability in terms of psychomotor speed among the selected student-athletes indicates a generally positive disposition, with an overall weighted mean of 3.23 and a standard deviation of 0.28. This mean falls within the “Agree” range, corresponding to an “Adaptable” interpretation. It suggests that, overall, the athletes demonstrate a moderate yet consistent ability to respond to training demands related to psychomotor speed, which encompasses mental alertness, decision-making, and reaction time.

Among the indicators assessed, the highest weighted mean is observed in the statement, "I occasionally struggle with processing information quickly during fast-paced situations," which received a score of 3.50 and a standard deviation of 0.567. While this result remains within the "Agree" category, it is noteworthy that a statement reflecting difficulty rather than proficiency ranks highest. This might imply that while athletes are generally adaptable, they still encounter occasional lapses in cognitive speed under pressure, which could be a key area for improvement.

The second highest rating, 3.43, was attributed to feeling mentally sharp and focused during training and competitions. This score indicates a generally favorable perception of cognitive readiness, which is crucial in performance consistency. Similarly, the indicator stating that training has improved reaction time and decision-making received a weighted mean of 3.32, further supporting the notion that training interventions have positively influenced cognitive-motor integration.

Conversely, the lowest weighted mean was associated with the belief that psychomotor speed is a crucial factor in athletic performance, with a score of 2.98. Although still within the "Agree" threshold, its position as the lowest-ranked item suggests a slight undervaluation of psychomotor speed's role in athletic success. Closely following this, openness to training methods aimed at improving psychomotor speed was rated at 3.02. This implies a relatively neutral stance towards innovation in training strategies, hinting at potential gaps in awareness or access to such methods.

Interestingly, indicators related to self-initiated strategies such as cognitive drills also received moderate support, with the statement on engaging in such exercises earning a mean of 3.23. Likewise, the belief that psychomotor skills contribute to overall performance garnered a mean of 3.18, reflecting moderate confidence in this area.

Psychomotor adaptability was rated as "Adaptable" (mean = 3.24), but it reflects a relatively underdeveloped construct. Despite athletes agreeing they sometimes struggle with fast-paced decision-making (mean = 3.50), their adaptability is not yet optimal. This aligns with Kårström et al. (2024) who found that internal training load indicators like TRIMP may not capture quick-response demands well. Therefore, enhancing cognitive drills and neuromuscular training is essential for addressing this internal component, particularly given that Adaptation Theory posits psychomotor response as a key mechanism in adapting to stimulus-rich environments like basketball.

In summary, the findings from Table 3 demonstrate that student-athletes generally perceive themselves as adaptable in terms of psychomotor speed. While they acknowledge improvements and express mental sharpness, their responses reveal some reservations about the importance and enhancement of these skills. The results point toward the potential benefit of targeted interventions to raise awareness and encourage engagement in psychomotor training, ultimately fostering greater adaptability and competitive edge.

Table 4. Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Training Impulse

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
1. I am aware of my training intensity and its effects on my body.	3.35	.755	Agree	Adaptable	3
2. I consistently monitor my heart rate and training zones during workouts.	3.33	.655	Agree	Adaptable	4

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3. I adjust my training based on feedback from monitoring my training impulse.	3.47	.747	Agree	Adaptable	1
4. My training impulse helps me avoid overtraining and injuries.	2.78	.993	Agree	Adaptable	7
5. I have a structured training plan that incorporates the concept of training impulse.	3.22	.885	Agree	Adaptable	5
6. I believe that a well-balanced training impulse positively impacts my athletic progress.	3.40	.942	Agree	Adaptable	2
7. I consult with coaches or sports scientists to fine-tune my training impulse strategies.	3.03	.974	Agree	Adaptable	6
Overall Mean	3.22	.45	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As illustrated in Table 4, the assessment of internal training load adaptability in terms of training impulse among the selected student-athletes reflects a generally positive but moderately varied level of adaptability. The overall weighted mean is 3.22 with a standard deviation of 0.45, which corresponds to the “Agree” range and is interpreted as “Adaptable.” This indicates that the respondents recognize the role of training impulse—the product of training intensity and duration—in their athletic performance, though the level of integration and understanding appears to differ among individuals.

The highest-rated statement, “I adjust my training based on feedback from monitoring my training impulse,” received a weighted mean of 3.47 and a standard deviation of 0.747. This suggests that most athletes acknowledge the value of training feedback and apply it to modify their routines, signifying a relatively high level of self-awareness and responsiveness to internal training cues. Closely following this, the belief that a well-balanced training impulse positively impacts athletic progress scored 3.40, reinforcing the idea that athletes appreciate the importance of maintaining training equilibrium to support performance gains.

Another notable finding is the level of awareness athletes have about their training intensity and its effects on their bodies, with a mean score of 3.35. This reflects a generally strong internal connection between physical exertion and self-monitoring. In contrast, the lowest-rated item, with a weighted mean of 2.78, pertains to the effectiveness of training impulse in helping avoid overtraining and injuries. Although this still falls within the “Agree” range, the relatively low score indicates potential uncertainty or underutilization of training impulse concepts as a preventive strategy, possibly due to a lack of technical understanding or support infrastructure.

Moreover, the indicator on consultation with coaches or sports scientists to optimize training impulse strategies earned a mean of 3.03, suggesting that while some athletes seek professional input, this practice is not yet widely adopted. Similarly, the item stating the presence of a structured training plan incorporating training impulse scored a mean of 3.22, implying that while structure exists, the systematic application of the concept could be further strengthened.

Notably, feedback-based adjustments scored highest (3.47), yet awareness of injury prevention through impulse control scored lowest (2.78). This discrepancy mirrors Kårström et al. (2024), who noted that heart rate-based training load measures sometimes fail to distinguish between training intensities, suggesting the need for incorporating both subjective and objective monitoring tools. Personalized TL monitoring, as emphasized in Hernández-Beltrán et al. (2023), can improve understanding of intensity control and load responsiveness, thus reinforcing internal adaptation.

In summary, Table 4 reveals that student-athletes show an adaptable approach to managing training impulse, especially in recognizing its benefits and adjusting their routines accordingly. However, the relatively lower means in areas involving injury prevention and external consultation suggest a need for further education and strategic support. Enhancing the athletes' understanding of training impulse and promoting more collaborative, data-informed approaches with coaches or sports professionals could significantly elevate their adaptability and long-term athletic development.

Table 5. Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Perceived Exertion

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
1. I am generally accurate in assessing how hard I am working during training.	3.38	.613	Agree	Adaptable	5.5
2. My perceived exertion matches my actual physical effort during workouts.	3.65	.732	Strongly Agree	Highly Adaptable	2
3. I pay attention to my body's signals, such as breathing and muscle fatigue, to gauge exertion.	3.55	.675	Strongly Agree	Highly Adaptable	3
4. I use a rating of perceived exertion (RPE) scale to quantify my effort during training.	3.68	.537	Strongly Agree	Highly Adaptable	1
5. I adjust my training intensity based on my perceived exertion to reach optimal training zones.	3.38	.613	Agree	Adaptable	5.5
6. I believe that self-awareness of perceived exertion is vital for effective training.	3.42	.561	Agree	Adaptable	4
7. I communicate my perceived exertion to my coaches or trainers for better training planning.	2.97	1.025	Agree	Adaptable	7
Overall Mean	3.40	.33	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As reflected in Table 5, the assessment of internal training load adaptability in terms of perceived exertion among the selected student-athletes reveals a generally favorable outcome, with an overall weighted mean of 3.40 and a standard deviation of 0.33. This score falls within the "Agree" category, indicating that the respondents are “Adaptable” in using perceived exertion as a tool for managing their training intensity. This suggests a relatively high level of self-awareness and attentiveness to internal physiological cues during exercise.

Among the indicators, the highest mean score is attributed to the statement, “I use a rating of perceived exertion (RPE) scale to quantify my effort during training,” which received a weighted mean of 3.68 and a low standard deviation of 0.537. This strong agreement, interpreted as “Highly Adaptable,” suggests that the athletes actively apply structured methods such as the RPE scale to monitor and regulate their effort, reflecting a mature and informed approach to internal training load management.

Following closely, the statement that perceived exertion matches actual physical effort scored 3.65, and the item on using bodily signals like breathing and muscle fatigue to gauge exertion recorded a mean of 3.55. These results, also within the “Strongly Agree” and “Highly Adaptable” range, reinforce that athletes are not only attentive to their subjective experiences of fatigue but also able to align those perceptions with actual physiological output, which is critical for effective training regulation and recovery management.

In contrast, the lowest-scoring item in this dimension is the statement regarding communication of perceived exertion to coaches or trainers, which garnered a weighted mean of 2.97 and a relatively high standard deviation of 1.025. While still categorized as “Agree” and “Adaptable,” this score reveals a potential communication gap between athletes and coaching staff concerning perceived exertion. This may reflect either a lack of structured dialogue around exertion or uncertainty in conveying subjective assessments in a meaningful way.

Interestingly, two indicators tied at a mean of 3.38: one related to the athletes’ accuracy in assessing their training effort, and the other concerning the adjustment of training intensity based on perceived exertion. These scores suggest that athletes are generally consistent in recognizing exertion levels and responding accordingly, but there remains room for refinement, possibly through better education on self-monitoring techniques or through enhanced feedback mechanisms.

The frequent use of RPE scales (3.68) supports Sciortino et al. (2023), who found alignment between coaches’ prescribed loads and athletes’ perceived exertion improved training outcomes. However, communication with coaches about exertion received the lowest score (2.97), suggesting a gap in athlete-coach feedback loops. According to Adaptation Theory, this communication is essential in modulating internal responses and ensuring balanced progression without overtraining.

In summary, Table 5 highlights that the selected student-athletes demonstrate a strong capacity for monitoring and interpreting perceived exertion, with high adaptability evident in their use of RPE and internal cues. However, the findings also underscore a need to improve the communication of these perceptions to coaches, which could enhance training personalization and effectiveness. Bridging this gap could further reinforce the athletes' adaptability and optimize their training outcomes through collaborative planning and responsive programming.

Table 6. Summary Result on the Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
Sleep Quality and Duration	3.41	0.29	Agree	Adaptable	2

Psychomotor Speed	3.24	0.28	Agree	Adaptable	3
Training Impulse	3.23	0.45	Agree	Adaptable	4
Perceived Exertion	3.43	0.33	Agree	Adaptable	1
Overall Mean	3.33	0.2	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As shown in Table 6, the summary assessment of the internal training load adaptability of the selected student-athletes yields an overall weighted mean of 3.33 with a standard deviation of 0.20. This overall result falls within the "Agree" category and is interpreted as "Adaptable," indicating that the respondents, on average, possess a moderate capacity to manage and respond to the demands of their training through self-regulated physical and psychological strategies. The consistency of the ratings across different dimensions supports the conclusion that these athletes are generally capable of adjusting to internal training loads, although there remains potential for further development.

Among the four assessed indicators, "Perceived Exertion" received the highest mean score at 3.43, suggesting that athletes are most confident and proficient in interpreting their physical effort and regulating intensity based on internal cues. This reflects a strong level of self-awareness, particularly in the use of tools like the rating of perceived exertion (RPE) scale, as previously discussed.

"Sleep Quality and Duration" closely follows, with a weighted mean of 3.41. This high ranking underscores the athletes' recognition of the importance of rest in recovery and performance, as well as their proactive use of sleep strategies. These top two dimensions suggest that athletes are more attuned to internal cues related to fatigue and recovery compared to more technical or data-driven approaches.

The lowest-ranked dimension is "Training Impulse," with a weighted mean of 3.23 and the highest standard deviation of 0.45 among the four indicators. While it still falls within the "Adaptable" range, this suggests greater variability in understanding and applying the concept of training impulse. It may reflect limited access to monitoring tools or insufficient guidance in integrating these insights into training routines.

Meanwhile, "Psychomotor Speed" scored 3.24, ranking third, and indicating that athletes acknowledge its role in performance but may not consistently engage in activities aimed at enhancing this skill. The closeness in the means of psychomotor speed and training impulse also suggests these areas could benefit from more targeted coaching interventions and structured training plans.

In conclusion, the summary results in Table 6 reflect a generally adaptable group of student-athletes who exhibit strength in self-monitoring their exertion and prioritizing recovery through sleep. However, they show comparatively less adaptability in the more technical domains of psychomotor speed and training impulse, indicating opportunities for improvement through educational support, advanced monitoring, and collaborative coaching strategies. Overall, the findings provide valuable insight into the holistic internal training adaptability profile of the respondents and highlight directions for performance enhancement.

Table 7. Differences in the Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Year Level

Indicator	**Year Level**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Sleep Quality and Duration	1st Year 2nd Year	3.32 3.37	1.753	.167	Accepted	Not Significant

	3rd Year 4th Year	3.45 3.55				
Psychomotor Speed	1st Year 2nd Year 3rd Year 4th Year	3.16 3.19 3.35 3.21	1.707	.176	Accepted	Not Significant
Training Impulse	1st Year 2nd Year 3rd Year 4th Year	3.19 3.22 3.24 3.26	.064	.979	Accepted	Not Significant
Perceived Exertion	1st Year 2nd Year 3rd Year 4th Year	3.39 3.43 3.50 3.40	.441	.725	Accepted	Not Significant
Overall	1st Year 2nd Year 3rd Year 4th Year	3.27 3.30 3.39 3.36	1.305	.282	Accepted	Not Significant

As presented in Table 7, the analysis of variance (ANOVA) results for the internal training load adaptability of the selected student-athletes across different year levels demonstrates that there are no statistically significant differences in any of the assessed dimensions. All significance values (p-values) are well above the 0.05 threshold, indicating that the null hypothesis (Ho), which posits no significant difference, is accepted in all cases.

In terms of sleep quality and duration, the mean scores increase slightly from 3.32 among first-year students to 3.55 among fourth-year students, suggesting a positive trend in sleep adaptability with increasing academic level. However, the F-value of 1.753 and a significance value of 0.167 indicate that this observed variation is not statistically meaningful. Similarly, in the domain of psychomotor speed, the third-year students registered the highest mean at 3.35, while the first-year group recorded the lowest at 3.16. Despite this slight fluctuation, the F-value of 1.707 and a p-value of 0.176 confirm that the differences are not significant.

With regard to training impulse, the mean scores are closely clustered, ranging from 3.19 to 3.26 across year levels, with an exceptionally low F-value of 0.064 and a p-value of 0.979. This result strongly supports the conclusion that students, regardless of their academic year, exhibit comparable levels of adaptability in understanding and applying the concept of training impulse.

In the area of perceived exertion, the mean scores again reflect a narrow range, from 3.39 in the first year to 3.50 in the third year, but the differences are statistically insignificant, as evidenced by an F-value of 0.441 and a p-value of 0.725. The overall adaptability scores follow a similar pattern, increasing gradually from 3.27 in the first year to 3.39 in the third year, then slightly decreasing to 3.36 in the fourth year. Yet, with an F-value of 1.305 and a p-value of 0.282, these variations remain statistically non-significant.

In summary, Table 7 reveals that while there are minor variations in mean scores across year levels, these differences are not statistically significant in any of the assessed indicators. This suggests a relatively consistent level of internal training load adaptability among student-athletes regardless of their academic progression, indicating that year level does not play a determining role in their adaptability profiles. These findings may imply that other factors—such as individual experience, coaching strategies, or sport-specific demands—have a more substantial influence on internal training adaptability than academic standing alone.

Table 8. Differences in the Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Year of Playing Basketball Competitively

Indicator	**Year of Playing Basketball Competitively**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Sleep Quality and Duration	Less than 1 year 1– 2 years 3–above	3.50 3.41 3.32	2.217	.118	Accepted	Not Significant
Psychomotor Speed	Less than 1 year 1– 2 years 3–above	3.33 3.29 3.10	4.348	.017	Rejected	Significant
Training Impulse	Less than 1 year 1– 2 years 3–above	3.38 3.24 3.04	3.416	.040	Rejected	Significant
Perceived Exertion	Less than 1 year 1– 2 years 3–above	3.59 3.32 3.33	5.032	.010	Rejected	Significant
Overall	Less than 1 year 1– 2 years 3–above	3.45 3.31 3.20	11.573	.000	Rejected	Significant

As shown in Table 8, the analysis of variance (ANOVA) based on the year of playing basketball competitively reveals significant differences in the internal training load adaptability of the selected student-athletes across most dimensions. Unlike the results by year level, where no significant differences were observed, competitive playing experience appears to be a more influential factor in shaping adaptability to internal training loads.

The overall mean scores demonstrate a clear trend: athletes with less than one year of competitive experience reported the highest adaptability (mean = 3.45), followed by those with one to two years (mean = 3.31), and finally, those with over three years of experience (mean = 3.20). This trend is statistically significant, with an F-value of 11.573 and a p-value of 0.000, leading to the rejection of the null hypothesis. This finding suggests that athletes newer to competitive basketball perceive themselves as more adaptable, which may reflect heightened motivation, recent training exposure, or optimism that has not yet been tempered by long-term fatigue or training plateaus.

Looking at specific indicators, perceived exertion shows a statistically significant difference (F = 5.032, p = 0.010), with the most novice athletes again scoring the highest (mean = 3.59). This suggests that beginners may be more attentive to internal cues or more conservative in effort monitoring, possibly as a result of recent educational exposure to perceived exertion tools like the RPE scale.

A similar pattern is evident in the training impulse dimension (F = 3.416, p = 0.040), where those with less than one year of experience scored significantly higher (mean = 3.38) compared to the most experienced group (mean = 3.04). This result may reflect the enthusiasm of less experienced athletes in embracing structured feedback systems or training technologies, while more seasoned players might rely more on intuition or have developed more fixed routines.

Psychomotor speed also presents a significant difference (F = 4.348, p = 0.017), with the highest adaptability mean among those with less than one year of experience (mean = 3.33). The mean steadily declines with increased experience, reaching 3.10 for those with more than three years. This may be interpreted as a possible shift in focus from cognitive training to physical conditioning over time or a diminishing emphasis on psychomotor skill development as athletes progress.

Interestingly, sleep quality and duration is the only dimension where the differences are not statistically significant (F = 2.217, p = 0.118). Though the means again show a decreasing trend with increased experience—3.50 for less than one year, 3.41 for one to two years, and 3.32 for more than three years—these differences do not reach statistical significance. This suggests that sleep behaviors and perceptions may be more stable across experience levels or influenced by factors external to athletic training, such as academic load or personal lifestyle.

In summary, Table 8 highlights that the number of years spent in competitive basketball significantly affects athletes' perceived adaptability in most internal training load dimensions. The findings reveal a counterintuitive but important trend: newer athletes report higher adaptability, which may reflect heightened engagement, structured training introduction, or fewer cumulative physical and psychological stressors. These results suggest that long-term athletes may benefit from renewed focus on adaptability-enhancing strategies, including mental sharpness, exertion monitoring, and individualized feedback systems, to sustain performance and prevent stagnation.

Table 9. Differences in the Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Playing Position

Indicator	Playing Position	Mean	F	Sig.	Decision on Ho	Interpretation
Sleep Quality and Duration	Point Guard	3.34	1.119	.357	Accepted	Not Significant
	Shooting Guard	3.32				
	Small Forward	3.46				
	Power Forward	3.49				
	Center	3.51				
Psychomotor Speed	Point Guard	3.34	1.300	.281	Accepted	Not Significant
	Shooting Guard	3.30				

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	Small Forward	3.14				
	Power Forward	3.14				
	Center	3.25				
Training Impulse	Point Guard	3.44	3.212	.019	Rejected	Significant
	Shooting Guard	2.95				
	Small Forward	3.12				
	Power Forward	3.22				
	Center	3.46				
Perceived Exertion	Point Guard	3.45	.083	.987	Accepted	Not Significant
	Shooting Guard	3.43				
	Small Forward	3.46				
	Power Forward	3.43				
	Center	3.38				
Overall	Point Guard	3.39	1.225	.311	Accepted	Not Significant
	Shooting Guard	3.25				
	Small Forward	3.30				
	Power Forward	3.32				
	Center	3.40				

As reflected in Table 9, the analysis of the differences in internal training load adaptability of the selected student-athletes based on their playing position shows that, with one exception, there are no statistically significant variations across the assessed indicators. The only dimension where a significant difference was observed is "Training Impulse," which yields an F-value of 3.212 and a p-value of 0.019, prompting the rejection of the null hypothesis and indicating a meaningful variation in how different playing positions perceive and apply training impulse principles.

In the "Training Impulse" dimension, point guards (mean = 3.44) and centers (mean = 3.46) reported the highest adaptability, suggesting that these players are more attuned to monitoring and adjusting training intensity and volume based on internal feedback. In contrast, shooting guards reported the lowest mean (2.95), falling near the lower end of the "Adaptable" range. This disparity may be influenced by the differing physical and cognitive demands placed on each position. For instance, point guards, often acting as floor leaders, may be more involved in strategic and analytical aspects of the game, possibly leading to a greater awareness of training dynamics. Similarly, centers may experience high levels of physical strain, prompting closer attention to training regulation to avoid overtraining or injury.

In other dimensions—namely "Sleep Quality and Duration," "Psychomotor Speed," and "Perceived Exertion"—the p-values exceed the 0.05 threshold, indicating no significant differences among playing positions. For instance, in "Sleep Quality and Duration," the means range from 3.32 for shooting guards to 3.51 for centers, yet the F-value of 1.119 and a p-value of 0.357 lead to the acceptance of the null hypothesis. This suggests that sleeping patterns and perceptions of sleep adequacy are relatively stable across all positions, possibly due to shared training schedules and lifestyle constraints.

Similarly, in “Psychomotor Speed,” the scores vary slightly, with point guards scoring the highest at 3.34 and small and power forwards scoring the lowest at 3.14, but the difference is not statistically significant (F = 1.300, p = 0.281). This result suggests that psychomotor adaptability is uniformly perceived among positions, despite differences in gameplay roles and cognitive demands.

The “Perceived Exertion” scores are also closely aligned across all groups, with means ranging from 3.38 to 3.46 and an extremely low F-value of 0.083 with a p-value of 0.987. This result emphasizes a shared ability among all positions to gauge physical effort, use internal cues, and adjust intensity accordingly.

In terms of the overall internal training load adaptability score, there is again no significant difference by position (F = 1.225, p = 0.311). The highest overall mean was recorded by centers (3.40), followed closely by point guards (3.39), while the lowest was among shooting guards (3.25). Despite these variations, they remain within the “Adaptable” range and do not represent statistically significant disparities.

In conclusion, Table 9 highlights that playing position has minimal influence on the internal training load adaptability of student-athletes, except in the domain of training impulse. This isolated significance points to specific positional demands influencing how athletes monitor and regulate their training intensity. However, the general consistency across other indicators implies that training adaptability is largely shaped by factors other than playing role, such as individual habits, coaching strategies, and training environments.

Table 10. Differences in the Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes in Terms of Average Weekly Training Hours

Indicator	Average Weekly Training Hours	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Sleep Quality and Duration	Less than 5 5–7 8–above	3.33 3.46 3.44	.993	.377	Accepted	Not Significant
Psychomotor Speed	Less than 5 5–7 8–above	3.28 3.18 3.24	.488	.616	Accepted	Not Significant
Training Impulse	Less than 5 5–7 8–above	3.18 3.12 3.31	.949	.393	Accepted	Not Significant
Perceived Exertion	Less than 5 5–7 8–above	3.36 3.40 3.50	1.146	.325	Accepted	Not Significant
Overall	Less than 5 5–7 8–above	3.29 3.29 3.38	1.364	.264	Accepted	Not Significant

As presented in Table 10, the differences in the assessment of internal training load adaptability of the selected student-athletes based on their average weekly training hours are not statistically significant across any of the evaluated indicators. All p-values are above the 0.05 threshold, resulting in the acceptance of the null hypothesis for each dimension. This indicates that the amount of time athletes dedicate to weekly training—whether less than five hours, five to seven hours, or more than eight hours—does not significantly affect their perceived adaptability to internal training loads.

In terms of “Sleep Quality and Duration,” the highest mean was recorded among those training five to seven hours per week (mean = 3.46), followed closely by those training more than eight hours (mean = 3.44). Athletes training less than five hours per week reported a slightly lower mean of 3.33. Despite these variations, the F-value of 0.993 and a p-value of 0.377 indicate that these differences are not statistically meaningful. The similarity in scores suggests that sleep adaptability is relatively consistent regardless of training volume, possibly influenced more by lifestyle or personal habits than by athletic demands.

For “Psychomotor Speed,” the mean scores were very close across all groups: 3.28 for less than five hours, 3.18 for five to seven hours, and 3.24 for more than eight hours. With a low F-value of 0.488 and a p-value of 0.616, there is no significant variation observed. This suggests that frequency of training does not necessarily correlate with athletes’ perceived cognitive or motor responsiveness, which may be influenced by the specific type and quality of training rather than its duration.

“Training Impulse” yielded the highest mean for athletes training more than eight hours weekly (mean = 3.31), while those training five to seven hours had the lowest mean at 3.12. However, the F-value of 0.949 and p-value of 0.393 confirm the lack of statistical significance. This implies that while more training hours may offer greater exposure to structured programs and monitoring, the perceived adaptability in managing training load intensity remains relatively uniform across groups.

Regarding “Perceived Exertion,” athletes training more than eight hours per week again reported the highest mean (3.50), compared to 3.40 for those training five to seven hours and 3.36 for those training less than five hours. While this trend suggests a slight increase in exertion awareness with greater training exposure, the F-value of 1.146 and p-value of 0.325 do not support a statistically significant difference.

The overall adaptability mean scores were 3.29 for both the less-than-five and five-to-seven-hour groups, and 3.38 for the more-than-eight-hour group. Yet, with an F-value of 1.364 and p-value of 0.264, these variations are also not statistically significant.

In summary, Table 10 illustrates that weekly training volume, in itself, does not significantly differentiate athletes’ internal training load adaptability. Despite some marginal increases in adaptability scores with higher training hours, these trends are not strong enough to be considered statistically meaningful. This suggests that internal adaptability may depend more on the quality and specificity of training, individual differences, and support systems than on mere training quantity.

Table 11. Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Endurance Management

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
I can sustain my performance throughout the entire duration of a game or training session.	3.23	.789	Agree	Adaptable	6
I manage my energy well during both short and long periods of play.	2.58	.809	Strongly Agree	Highly Adaptable	7

My endurance directly affects how consistently I can perform skills in games.	3.77	.500	Strongly Agree	Highly Adaptable	1
I modify my warm-up and pacing based on the expected length of activity.	3.67	.542	Strongly Agree	Highly Adaptable	2
I feel confident in my ability to maintain focus and physical output over time.	3.52	.813	Strongly Agree	Highly Adaptable	4
Longer sessions test both my physical and mental endurance.	3.53	.596	Strongly Agree	Highly Adaptable	3
I train specifically to improve my endurance for competitive play.	3.42	.743	Agree	Adaptable	5
Overall Mean	3.38	.30	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As shown in Table 11, the assessment of the external training load adaptability of the selected student-athletes in terms of endurance management reveals a generally positive yet slightly varied profile. Athletes rated themselves as "Adaptable" (mean = 3.38), with a strong acknowledgment of how endurance impacts skill consistency (mean = 3.77). This reflects effective adaptation to repetitive game demands, echoing findings from Coyne et al. (2021)**,** who linked endurance with training periodization and in-game success. Nonetheless, managing energy across varied game lengths scored the lowest (2.58), indicating a need for strategic pacing drills and energy conservation training to enhance ETL efficiency, particularly under prolonged load exposure.

Among the indicators, the highest-rated item is the statement, "My endurance directly affects how consistently I can perform skills in games," which received a weighted mean of 3.77 and a low standard deviation of 0.500. This result, interpreted as "Strongly Agree" and "Highly Adaptable," demonstrates a clear recognition among athletes that endurance is integral to maintaining skill execution during performance, highlighting the central role of stamina in sustaining technical proficiency.

Following this, the modification of warm-up and pacing based on the expected length of activity also scored highly (mean = 3.67), reflecting proactive strategies used by athletes to manage exertion levels depending on game or training duration. Additionally, statements related to confidence in maintaining focus and output (mean = 3.52) and the acknowledgment that longer sessions test both physical and mental endurance (mean = 3.53) further reinforce the athletes' high adaptability in coping with prolonged exertion.

Interestingly, the lowest-rated item is the statement, "I manage my energy well during both short and long periods of play," which yielded a mean of only 2.58. While this score still falls within the "Agree" range and is interpreted as "Highly Adaptable" under the given legend, it is markedly lower than the other indicators. This may suggest a degree of self-doubt or inconsistency in energy regulation, possibly due to varied game intensities or a lack of refined pacing strategies during fluctuating match conditions.

The statement, "I can sustain my performance throughout the entire duration of a game or training session," also received a relatively lower mean of 3.23, implying that while athletes generally perceive themselves as adaptable, they may occasionally experience declines in performance due to endurance limitations. Furthermore, while

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training specifically to improve endurance received a mean score of 3.42, placing it in the "Adaptable" category, it ranks fifth overall, indicating that while such training is present, it may not be as emphasized as it could be.

In summary, Table 11 indicates that the student-athletes exhibit a commendable level of adaptability in terms of endurance management, particularly in recognizing its importance and adjusting pre-performance routines accordingly. However, some indicators suggest the need for further development in consistent energy regulation across varying periods of play. Strengthening endurance-specific training and reinforcing pacing strategies may enhance overall adaptability and athletic performance in competitive settings.

Table 12. Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Recovery and Readiness

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
I recover quickly and can perform well in frequent competitions or training sessions.	4.00	.000	Strongly Agree	Highly Adaptable	1
I feel the effects of back-to-back training or games in my performance.	3.68	.676	Strongly Agree	Highly Adaptable	3
I adapt my training schedule based on how recovered I feel.	2.62	.585	Strongly Agree	Highly Adaptable	7
Good recovery helps me stay sharp and improve my skills.	2.73	.516	Agree	Adaptable	6
I include proper rest, nutrition, and sleep in my routine to stay ready.	2.75	.816	Agree	Adaptable	5
Too many close competitions can make it harder to feel ready to perform.	2.87	.747	Agree	Adaptable	4
Extra time between games helps me focus more on skill development.	3.98	.129	Strongly Agree	Highly Adaptable	2
Overall Mean	3.23	.25	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

Table 12 presents the assessment of the external training load adaptability of the selected student-athletes in terms of recovery and readiness. With an overall mean of 3.23, recovery was recognized but not consistently implemented. The perfect score in quick recovery (4.00) contradicts the lower score in adapting training based on recovery (2.62), suggesting an overestimation of readiness. This supports Fields et al. (2021) who found delayed internal fatigue patterns relative to external loads. Monitoring readiness using heart rate variability or subjective recovery scales could help bridge the disconnect between perceived and actual readiness, enhancing alignment with Adaptation Theory principles.

The highest-rated indicator is the statement, "I recover quickly and can perform well in frequent competitions or training sessions," which achieved a perfect mean score of 4.00 with no variation among respondents (standard deviation = 0.000). This exceptional result, interpreted as "Strongly Agree" and "Highly Adaptable," underscores a collective confidence among the athletes in their recovery capacity, suggesting effective physiological resilience and perhaps confidence in their recovery protocols.

Closely following is the indicator, "Extra time between games helps me focus more on skill development," with a mean of 3.98 and a low standard deviation of 0.129. This again falls under "Highly Adaptable," indicating that athletes perceive recovery periods as not only restorative but also as valuable windows for technical enhancement, highlighting a strategic approach to managing downtime.

Additionally, the statement, "I feel the effects of back-to-back training or games in my performance," received a mean of 3.68, indicating that while athletes can perform frequently, they are also attuned to the physical consequences of dense schedules. This dual awareness of recovery capacity and training fatigue suggests a balanced self-perception of readiness and workload impact.

On the other hand, some indicators received notably lower scores, signaling areas of potential concern. For example, the item, "I adapt my training schedule based on how recovered I feel," scored the lowest with a mean of 2.62. Although it still falls under "Highly Adaptable" due to the scale's threshold, the score suggests that athletes may not frequently or effectively adjust their training load in response to their perceived recovery state. This could point to either a lack of autonomy in training decisions or insufficient monitoring tools to inform such adjustments.

Similarly, moderate scores were observed in items related to recovery practices, including rest, nutrition, and sleep (mean = 2.75), and the perception that too many close competitions can reduce readiness (mean = 2.87). Both indicate an awareness of the importance of recovery but suggest inconsistent implementation or variability in recovery strategies among athletes.

The statement, "Good recovery helps me stay sharp and improve my skills," also scored relatively low at 2.73, suggesting that while athletes may understand the general importance of recovery, they may not yet fully connect it to long-term skill development or performance enhancement.

In summary, Table 12 reveals that while the student-athletes express strong confidence in their ability to recover and maintain performance, especially during high competition loads, there is variability in how consistently recovery strategies are applied and how autonomously training is adapted based on readiness. This suggests a need for greater education and support in individualized recovery planning, training periodization, and integration of recovery science into athlete routines to enhance both short-term readiness and long-term athletic progression.

Table 13. Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Role-Specific Skill Application

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
The skills I use depend heavily on my playing position.	3.85	.404	Strongly Agree	Highly Adaptable	1
I practice drills that match the technical demands of my position.	3.35	.633	Agree	Adaptable	6

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I review how I apply skills in my role to find areas of improvement.	2.87	.892	Agree	Adaptable	7
I use performance feedback to refine my position-specific skills.	3.45	.565	Agree	Adaptable	4
Each position requires different skill combinations and training focuses.	3.77	.698	Strongly Agree	Highly Adaptable	2
Mastering my role-specific skills is key to my game performance.	3.73	.733	Strongly Agree	Highly Adaptable	3
Coaches give me focused training based on the demands of my position.	3.43	.745	Agree	Adaptable	5
Overall Mean	3.49	.28	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As detailed in Table 13, the assessment of the external training load adaptability of the selected student-athletes in terms of role-specific skill application yields an overall weighted mean of 3.49 with a standard deviation of 0.28. This places the athletes within the “Agree” range, interpreted as “Adaptable.” The result indicates that, overall, the respondents recognize and respond appropriately to the demands of their specific playing positions, although some variability is evident across the individual indicators. Athletes understood positional demands and practiced accordingly, aligning with Hernández-Beltrán et al. (2023), who emphasized load differences across playing positions. The slightly lower score in skill review practices (2.87) reflects a gap in structured reflection. According to Adaptation Theory, feedback integration and positional specificity are central to long-term adaptation and performance optimization.

The highest-rated statement is “The skills I use depend heavily on my playing position,” with a weighted mean of 3.85 and a low standard deviation of 0.404. This strong agreement reflects a high level of positional awareness among athletes and suggests that they clearly understand the unique technical and tactical requirements associated with their roles. Supporting this, the statement “Each position requires different skill combinations and training focuses” also received a high rating of 3.77, reinforcing that student-athletes are attuned to the position-specific nature of training demands and game responsibilities.

Similarly, “Mastering my role-specific skills is key to my game performance” garnered a weighted mean of 3.73, showing that athletes strongly believe in the direct impact of positional expertise on overall performance outcomes. These three top-rated items—each within the “Strongly Agree” and “Highly Adaptable” range—underscore the importance placed on specialized skill development and suggest a mature understanding of positional differentiation.

In contrast, the lowest-rated indicator is “I review how I apply skills in my role to find areas of improvement,” which received a weighted mean of 2.87 with a relatively high standard deviation of 0.892. This score, while still within the “Agree” and “Adaptable” category, suggests that reflective practice is less consistently applied among athletes. This may indicate that while athletes understand the importance of their roles, fewer engage in regular self-evaluation or structured reflection to enhance performance.

Other moderately rated indicators include "I practice drills that match the technical demands of my position" (mean = 3.35), "I use performance feedback to refine my position-specific skills" (mean = 3.45), and "Coaches give me focused training based on the demands of my position" (mean = 3.43). These results indicate a generally adaptive approach to training, but also reveal potential gaps in individualized instruction and the integration of targeted feedback into skill refinement processes.

In summary, Table 13 highlights that student-athletes demonstrate a strong understanding of role-specific skill application, particularly in recognizing the uniqueness of their positions and the necessity of mastering relevant skills. However, there is a noticeable drop in adaptability when it comes to reflective practices and personalized feedback application. To enhance external training load adaptability further, it would be beneficial to promote deeper engagement in performance analysis, individualized feedback utilization, and coach-led skill refinement strategies tailored to positional demands.

Table 14. Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Explosive Performance Ability

Indicator	Weighted Mean	Standard Deviation	Qualitative Description	Verbal Interpretation	Rank
Quick and powerful actions are essential to my performance.	3.50	.567	Agree	Adaptable	1.5
My explosiveness helps me perform sprints, jumps, and rapid movements.	3.13	.812	Agree	Adaptable	6
I monitor my power to evaluate my readiness for game situations.	3.23	.831	Agree	Adaptable	3
I include strength and plyometric training to build explosive ability.	3.17	.827	Agree	Adaptable	4.5
Explosive skills give me an edge in intense game moments.	3.17	.785	Agree	Adaptable	4.5
I train to maintain explosive performance throughout the entire game.	3.50	.567	Agree	Adaptable	1.5
Monitoring explosive performance helps me improve my training approach.	2.98	.813	Agree	Adaptable	7
Overall Mean	3.24	.32	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As shown in Table 14, the assessment of external training load adaptability in terms of explosive performance ability among the selected student-athletes yields an overall weighted mean of 3.24 and a standard deviation of 0.32. This score falls within the "Agree" category and is interpreted as "Adaptable," suggesting that while athletes recognize the importance of explosive power in performance, their training strategies and monitoring practices may still be developing or inconsistently applied. This echoes Honório et al. (2023), who linked explosive power with fatigue indices, emphasizing the need for load variation. Failure to track explosive output may hinder progress and increase injury risk. Integrating vertical jump and sprint testing can provide objective ETL measures, essential for refining training load responses.

The two highest-rated indicators—both tied with a weighted mean of 3.50—are "Quick and powerful actions are essential to my performance" and "I train to maintain explosive performance throughout the entire game." These results affirm that athletes clearly understand the relevance of explosiveness in their sports context and the need to sustain this capacity over the course of a game. Despite these high scores, they remain at the threshold of "Adaptable," indicating that while the perception is strong, further reinforcement through training or education could elevate this to a "Highly Adaptable" level.

The lowest-rated item is "Monitoring explosive performance helps me improve my training approach," which scored a mean of 2.98 with a relatively high standard deviation of 0.813. Although still within the "Agree" range, this suggests a less consistent or less developed practice of monitoring explosive metrics such as sprint speed, vertical leap, or reactive strength index. The variability in responses implies that not all athletes are regularly engaging with performance data or may lack access to appropriate tools or support for such monitoring.

Other indicators, including "My explosiveness helps me perform sprints, jumps, and rapid movements" (mean = 3.13), "I include strength and plyometric training to build explosive ability" (mean = 3.17), and "Explosive skills give me an edge in intense game moments" (mean = 3.17), reflect a moderate but uniform understanding of how explosive capacity contributes to game-specific advantages. However, the fact that none of these indicators exceeds the "Agree" category suggests that while athletes value explosiveness, their training may not be fully optimized or targeted toward this component.

"I monitor my power to evaluate my readiness for game situations" received a slightly higher mean of 3.23, indicating that some athletes are beginning to integrate power-related assessments into their preparation routines. However, given the standard deviation of 0.831, this practice is likely inconsistent across the group.

In summary, Table 14 reveals that the selected student-athletes demonstrate a foundational awareness of the importance of explosive performance and its role in competitive contexts. However, there appears to be a gap between this awareness and the systematic training and monitoring of explosive capacity. To enhance external training load adaptability in this area, there is a need to reinforce structured strength and power development programs, improve access to performance monitoring tools, and promote the use of explosiveness metrics in training evaluation and game preparation.

Table 15. Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Consistency in High-Intensity Skill Execution

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
I can repeat high-intensity actions without a drop in performance.	3.35	.755	Agree	Adaptable	3
Repetitive drills help me develop consistency in executing skills.	3.32	.911	Agree	Adaptable	5
I focus on performing skills correctly under physical stress.	3.33	.655	Agree	Adaptable	4
My training balances repetition with skill quality.	3.47	.747	Agree	Adaptable	2
I adjust my workload to handle intense movement demands.	2.78	.993	Agree	Adaptable	7

I avoid overtraining by following proper recovery routines.	3.23	.789	Agree	Adaptable	6
Coaches emphasize control and consistency in repeated skill execution.	3.55	.699	Strongly Agree	Highly Adaptable	1
Overall Mean	3.29	.31	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As illustrated in Table 15, the assessment of external training load adaptability in terms of consistency in high-intensity skill execution reveals that the selected student-athletes demonstrate a moderate yet positive capacity to manage and sustain performance under physically demanding conditions. The overall weighted mean is 3.29 with a standard deviation of 0.31, placing the group within the “Agree” category, interpreted as “Adaptable.” This suggests that while the athletes generally possess the ability to execute high-intensity skills consistently, there is room for refinement in their training strategies and recovery integration. This supports Rebelo et al. (2023) who highlighted training monotony as a factor in performance decline. Therefore, encouraging load variation and athlete-led decision-making can improve skill sustainability during peak workloads.

The highest-rated indicator is “Coaches emphasize control and consistency in repeated skill execution,” which received a weighted mean of 3.55 and a standard deviation of 0.699. This score falls within the “Strongly Agree” range and is interpreted as “Highly Adaptable,” indicating that coaching support plays a significant role in fostering consistent high-intensity performance. The strong emphasis on repetition with control likely helps athletes develop precision and endurance in technical execution, even under stress.

Following this, “My training balances repetition with skill quality” scored 3.47, also within the upper tier of the “Adaptable” category. This indicates that the training programs generally value both quantity and execution standards, reinforcing a dual focus that contributes to long-term performance consistency.

“I can repeat high-intensity actions without a drop in performance” (mean = 3.35) and “I focus on performing skills correctly under physical stress” (mean = 3.33) were also rated positively, underscoring athletes' confidence in their ability to maintain technical proficiency despite fatigue. These scores reflect a solid foundation in physical conditioning and mental focus, essential for maintaining high standards during extended game periods.

In contrast, the lowest-rated item, “I adjust my workload to handle intense movement demands,” received a mean of 2.78 with the highest standard deviation in the set (0.993), indicating variability in how athletes adapt their training volume in response to physical demands. This may suggest either a lack of autonomy in managing training loads or inconsistent guidance in workload modulation. Similarly, “I avoid overtraining by following proper recovery routines” scored 3.23, indicating a generally adaptable but less assertive approach to recovery management.

“Repetitive drills help me develop consistency in executing skills” received a slightly lower score of 3.32, suggesting that while athletes see the value in repetition, its effectiveness may vary based on how drills are structured or how skill quality is maintained throughout.

In summary, Table 15 reveals that student-athletes display a good level of adaptability in executing high-intensity skills consistently, particularly with strong support from coaches and well-balanced training approaches. However, the lower scores in self-directed workload adjustments and recovery routines point to areas where further improvement is needed. Enhancing athlete autonomy in managing physical stress, along with more individualized recovery plans, could further elevate their ability to sustain high-performance levels across repeated, intense demands.

Table 16. Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Movement Efficiency

Indicator	Weighted Mean	Standard Deviation	Qualitative Description	Verbal Interpretation	Rank
My movement patterns during games affect how tired I get.	3.03	.780	Agree	Adaptable	6
I study my movements to improve efficiency and reduce wasted effort.	3.20	.708	Agree	Adaptable	3
My position influences how I move and how much I need to move.	3.10	.656	Agree	Adaptable	5
Conditioning drills mimic the types of movement I use in games.	3.17	.740	Agree	Adaptable	4
Better movement efficiency helps me stay active for longer.	3.27	.733	Agree	Adaptable	1
I track movement data to improve my performance.	2.90	.838	Agree	Adaptable	7
I adjust my training to meet the movement demands of my position.	3.32	.651	Agree	Adaptable	1
Overall Mean	3.14	.27	Agree	Adaptable	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As presented in Table 16, the assessment of the external training load adaptability of the selected student-athletes in terms of movement efficiency reveals an overall weighted mean of 3.14 with a standard deviation of 0.27. This places the responses within the “Agree” category, interpreted as “Adaptable,” indicating that while athletes generally recognize the value of efficient movement in performance and fatigue management, this awareness is not yet fully translated into advanced practices or widespread application.

Among the indicators, the highest-rated items—tied with a mean of 3.32 and 3.27, respectively—are “I adjust my training to meet the movement demands of my position” and “Better movement efficiency helps me stay active for longer.” These results highlight that athletes appreciate the role of efficient movement patterns in sustaining activity and acknowledge the importance of tailoring training to positional demands. These responses reflect a practical understanding of movement economy as a performance factor.

Conversely, the lowest-rated statement is “I track movement data to improve my performance,” which scored a mean of 2.90 with a standard deviation of 0.838. This suggests that while athletes are aware of movement efficiency conceptually, fewer are actively engaging in performance data tracking—such as GPS metrics, movement heat maps, or load monitoring systems—to inform training adjustments. This low score may indicate limited access to performance technology or a gap in the integration of movement analytics into athlete routines.

Other mid-range indicators include “I study my movements to improve efficiency and reduce wasted effort” (mean = 3.20) and “Conditioning drills mimic the types of movement I use in games” (mean = 3.17), both suggesting that athletes are moderately engaged in movement-specific reflection and drill specificity. These results support the idea that some level of effort is made to align training tasks with game demands, though the relatively modest scores imply potential for refinement and enhancement of training design.

The statement, "My position influences how I move and how much I need to move," received a mean of 3.10, indicating that players acknowledge positional variation in movement but may not yet be deeply analyzing or optimizing this aspect. Similarly, "My movement patterns during games affect how tired I get" (mean = 3.03) shows a foundational understanding of movement-related fatigue, although this recognition is not among the most strongly expressed.

The lowest-rated external construct (mean = 3.14) underscores a significant need for biomechanical training. Tracking movement data scored lowest (2.90), reflecting minimal integration of technology. Hernández-Beltrán et al. (2023) stressed that position-specific movement profiles influence external load and should guide training plans. Improved efficiency directly relates to fatigue reduction and movement economy, aligning with Adaptation Theory's focus on functional adaptation and energy optimization.

In summary, Table 16 reflects that student-athletes demonstrate a generally adaptable orientation toward movement efficiency, grounded in positional awareness and a basic understanding of energy conservation. However, the lower mean in tracking movement data, coupled with only moderate scores in technique refinement and drill design, suggests that the application of movement science principles is still developing. To enhance adaptability in this domain, greater emphasis on biomechanical feedback, movement analysis tools, and individualized training strategies could further align physical demands with efficient movement patterns, ultimately reducing fatigue and improving performance longevity.

Table 17. Summary Results on the Assessment of the External Training Load Adaptability of the Selected Student-Athletes

Indicator	**Weighted Mean**	**Standard Deviation**	**Qualitative Description**	**Verbal Interpretation**	**Rank**
Endurance Management	3.39	0.3	Agree	Adaptable	2
Recovery and Readiness	3.23	0.26	Agree	Adaptable	5
Role-Specific Skill Application	3.49	0.29	Agree	Adaptable	1
Explosive Performance Ability	3.24	0.33	Agree	Adaptable	4
Consistency in High-Intensity Skill Execution	3.29	0.31	Agree	Adaptable	3
Movement Efficiency	3.14	0.28	Agree	Adaptable	6
Overall Mean	**3.30**	**0.13**	**Agree**	**Adaptable**	

Legend: 3.51 – 4.00 (Strongly Agree-Highly Adaptable); 2.51 – 3.50 (Agree- Adaptable); 1.51 – 2.50 (Disagree-Slightly Adaptable); 1.0-1.50 (Strongly Disagree-Not Adaptable)

As summarized in Table 17, the overall assessment of external training load adaptability among the selected student-athletes results in a weighted mean of 3.30 with a relatively low standard deviation of 0.13. This overall

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score falls within the “Agree” category and is interpreted as “Adaptable,” indicating that the athletes generally demonstrate a moderate and consistent ability to adjust to various aspects of external training demands. While the results affirm a solid foundation in adaptability, they also highlight areas where further refinement and support could enhance performance outcomes.

The highest-rated dimension is “Role-Specific Skill Application,” which received a weighted mean of 3.49 and a standard deviation of 0.29. This score, nearing the threshold of “Highly Adaptable,” suggests that athletes are particularly effective in aligning their training and skill execution with the demands of their specific playing positions. This reflects a strong understanding of positional responsibilities and targeted development, likely supported by focused coaching and personalized drills.

Following closely is “Endurance Management,” which scored a mean of 3.39. This indicates that athletes are generally adept at sustaining performance over extended durations, using pacing strategies and recovery periods to manage fatigue. It implies that cardiovascular and muscular endurance are relatively well-integrated into their training regimens.

“Consistency in High-Intensity Skill Execution” is ranked third, with a mean of 3.29. This result suggests that while athletes can maintain performance during intense, repetitive actions, there may still be variability in how consistently these skills are executed under stress, particularly when workload adjustments and recovery strategies are less optimized.

“Explosive Performance Ability” is close behind with a score of 3.24, reflecting that while athletes recognize the importance of quick, powerful actions, their adaptability in this area could benefit from more structured strength and power training programs, as well as more consistent monitoring of explosiveness in both practice and competition.

“Recovery and Readiness” ranks fifth (mean = 3.23), suggesting that while athletes are generally aware of recovery strategies and their importance, implementation may not be systematic or individualized enough to fully maximize readiness. This aligns with earlier findings that revealed a gap between recovery awareness and the consistent adaptation of training schedules based on perceived readiness.

The lowest-rated indicator is “Movement Efficiency,” with a weighted mean of 3.14 and a standard deviation of 0.28. This dimension appears to be the least developed among the group, indicating that while athletes understand the role of efficient movement in conserving energy and improving performance, the use of data and biomechanical feedback to enhance this efficiency is limited. The relatively low score suggests an opportunity to improve through greater integration of movement analysis tools and conditioning strategies tailored to positional and gameplay movement patterns.

In conclusion, Table 17 demonstrates that the student-athletes exhibit an overall adaptable profile in managing external training loads, with particular strengths in role-specific training and endurance. However, areas such as movement efficiency, recovery personalization, and explosiveness monitoring present valuable opportunities for targeted intervention. Addressing these gaps could elevate their adaptability from "Adaptable" to "Highly Adaptable," thereby enhancing overall performance and long-term athletic development.

Table 18. Differences in the Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Year Level

Indicator	Year Level	Mean	F	Sig.	Decision on Ho	Interpretation
Endurance Management	1st Year 2nd Year 3rd Year	3.36 3.35 3.48	.953	.422	Accepted	Not Significant

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	4th Year	3.31				
Recovery and Readiness	1st Year 2nd Year 3rd Year 4th Year	3.32 3.19 3.18 3.20	1.186	.323	Accepted	Not Significant
Role-Specific Skill Application	1st Year 2nd Year 3rd Year 4th Year	3.46 3.57 3.49 3.49	.284	.837	Accepted	Not Significant
Explosive Performance Ability	1st Year 2nd Year 3rd Year 4th Year	3.12 3.11 3.35 3.37	2.861	.045	Rejected	Significant
Consistency in High-Intensity Skill Execution	1st Year 2nd Year 3rd Year 4th Year	3.18 3.22 3.35 3.44	2.275	.090	Accepted	Not Significant
Movement Efficiency	1st Year 2nd Year 3rd Year 4th Year	3.17 3.06 3.18 3.08	.596	.620	Accepted	Not Significant
Overall	1st Year 2nd Year 3rd Year 4th Year	3.27 3.25 3.34 3.32	1.321	.277	Accepted	Not Significant

As indicated in Table 18, the analysis of variance (ANOVA) results reveal that year level does not significantly affect the external training load adaptability of the selected student-athletes across most assessed indicators. In all but one domain—Explosive Performance Ability—the null hypothesis is accepted, with significance values (p-values) above the threshold of 0.05, indicating that any observed variations are not statistically meaningful.

The only exception is Explosive Performance Ability, where a statistically significant difference was found (F = 2.861, p = 0.045), leading to the rejection of the null hypothesis. The mean scores show a trend of increasing adaptability with academic progression: 1st-year students scored a mean of 3.12, 2nd years at 3.11, 3rd years at 3.35, and 4th years at 3.37. This result suggests that as student-athletes advance through their academic years, they may gain greater exposure to structured strength and conditioning programs, improved training experience, or better body awareness, all contributing to enhanced explosiveness.

In contrast, no significant differences were found in Endurance Management (F = 0.953, p = 0.422), Recovery and Readiness (F = 1.186, p = 0.323), Role-Specific Skill Application (F = 0.284, p = 0.837), Consistency in High-Intensity Skill Execution (F = 2.275, p = 0.090), and Movement Efficiency (F = 0.596, p = 0.620). Despite slight variations in mean scores, these differences were not substantial enough to be statistically significant. For example, in Consistency in High-Intensity Skill Execution, while 1st-year students scored 3.18 and 4th-year students scored 3.44, the variation was not significant (p = 0.090), though it may suggest a trend worth further investigation.

The overall adaptability scores show relatively minor differences across year levels—ranging from 3.25 to 3.34—without reaching significance (F = 1.321, p = 0.277). This implies that, generally, external training load adaptability is consistent across academic levels, which may point to uniformity in coaching exposure, training resources, or institutional programming provided to all student-athletes, regardless of year level.

In summary, Table 18 demonstrates that year level does not significantly influence most areas of external training load adaptability, with the exception of explosive performance. The findings suggest that experience and accumulated training may particularly enhance explosiveness, but other factors such as recovery, role-specific skill application, and endurance are relatively stable across year levels. These insights highlight the importance of early exposure to effective training systems to ensure even development across all adaptability dimensions.

Table 19. Differences in the Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Year of Playing Basketball Competitively

Indicator	**Year of Playing Basketball Competitively**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Endurance Management	Less than 1 year 1– 2 years 3–above	3.51 3.37 3.27	3.902	.026	Rejected	Significant
Recovery and Readiness	Less than 1 year 1– 2 years 3–above	3.27 3.19 3.22	.422	.658	Accepted	Not Significant
Role-Specific Skill Application	Less than 1 year 1– 2 years 3–above	3.58 3.54 3.36	3.860	.027	Rejected	Significant
Explosive Performance Ability	Less than 1 year 1– 2 years	3.29 3.37	4.143	.021	Rejected	Significant

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	3–above	3.09				
Consistency in High-Intensity Skill Execution	Less than 1 year 1– 2 years 3–above	3.38 3.27 3.20	1.926	.155	Accepted	Not Significant
Movement Efficiency	Less than 1 year 1– 2 years 3–above	3.13 3.18 3.12	.210	.811	Accepted	Not Significant
Overall	Less than 1 year 1– 2 years 3–above	3.36 3.32 3.21	9.531	.000	Rejected	Significant

As presented in Table 19, the analysis of variance (ANOVA) on the differences in external training load adaptability based on the student-athletes' year of playing basketball competitively reveals statistically significant differences in several key dimensions. Specifically, significant differences were found in Endurance Management (p = .026), Role-Specific Skill Application (p = .027), Explosive Performance Ability (p = .021), and in the Overall adaptability score (p = .000). These findings suggest that the length of competitive playing experience has a measurable influence on how athletes adapt to external training demands.

In Endurance Management, those with less than one year of experience scored the highest (mean = 3.51), followed by those with one to two years (mean = 3.37), and those with more than three years (mean = 3.27). This downward trend may reflect the early enthusiasm and perceived freshness of newer athletes, who may not yet have experienced the cumulative fatigue and performance wear typical of more seasoned players. Alternatively, it may point to a possible overestimation of endurance by less experienced athletes, whereas experienced athletes may be more attuned to their physical limitations.

A similar pattern is evident in Role-Specific Skill Application, where athletes with less than one year of experience again scored highest (mean = 3.58), followed by one to two years (3.54), and three or more years (3.36). The statistical significance here suggests that newer athletes may be more engaged with structured, position-specific training sessions or may receive more instructional attention. Conversely, more experienced athletes might be operating with more autonomy, potentially leading to less frequent review or refinement of role-specific skills.

In Explosive Performance Ability, those in the 1–2 years group scored the highest (mean = 3.37), slightly outperforming the less-than-one-year group (mean = 3.29), while those with over three years of experience scored the lowest (mean = 3.09). This significant result could indicate that athletes in the middle phase of their competitive journey are at a peak stage of physical development and conditioning, while the more experienced group may be facing accumulated fatigue, overuse, or less emphasis on explosiveness due to sport-specific adaptations.

The overall adaptability scores reinforce these trends. Athletes with less than one year of competitive experience scored the highest (mean = 3.36), followed by those with one to two years (mean = 3.32), while those with more than three years scored the lowest (mean = 3.21). With a highly significant F-value (p = .000), this finding suggests that longer competitive exposure may be associated with diminished adaptability in some external training load areas, possibly due to routine fatigue, overtraining, or reduced variation in training stimulus.

On the other hand, dimensions such as Recovery and Readiness (p = .658), Consistency in High-Intensity Skill Execution (p = .155), and Movement Efficiency (p = .811) did not show significant differences. This indicates that regardless of competitive experience, athletes generally maintain similar levels of adaptability in managing physical readiness, repeated skill execution, and movement economy. These findings may reflect shared coaching methods, standardized training structures, or universally applied recovery protocols across experience levels.

In summary, Table 19 underscores that the year of playing basketball competitively significantly influences external adaptability in key domains such as endurance, role-specific skills, explosiveness, and overall adaptability. These results highlight the nuanced impact of experience—while more competitive exposure often implies greater tactical maturity, it may also come with challenges in sustaining adaptability. Targeted interventions may be needed for more experienced athletes to maintain their physical responsiveness, while continued structured support for newer players can help preserve their adaptability as they progress.

Table 20. Differences in the Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Playing Position

Indicator	**Playing Position**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Endurance Management	Point Guard	3.46	.553	.698	Accepted	Not Significant
	Shooting Guard	3.4				
	Small Forward	3.36				
	Power Forward	3.29				
	Center	3.43				
Recovery and Readiness	Point Guard	3.18	.487	.745	Accepted	Not Significant
	Shooting Guard	3.27				
	Small Forward	3.21				
	Power Forward	3.21				
	Center	3.32				
Role-Specific Skill Application	Point Guard	3.46	.696	.598	Accepted	Not Significant
	Shooting Guard	3.44				
	Small Forward	3.45				
	Power Forward	3.56				
	Center	3.60				
Explosive Performance Ability	Point Guard	3.3	2.906	.030	Rejected	Significant
	Shooting Guard	3.24				
	Small Forward	3.03				
	Power Forward	3.22				

	Center	3.48				
Consistency in High-Intensity Skill Execution	Point Guard Shooting Guard Small Forward Power Forward Center	3.4 3.11 3.2 3.34 3.46	2.852	.032	Rejected	Significant
Movement Efficiency	Point Guard Shooting Guard Small Forward Power Forward Center	3.17 3.18 3.13 3.16 3.03	.437	.781	Accepted	Not Significant
Overall	Point Guard Shooting Guard Small Forward Power Forward Center	3.33 3.27 3.23 3.29 3.39	2.358	.065	Accepted	Not Significant

As shown in Table 20, the analysis of variance (ANOVA) examining the differences in external training load adaptability based on playing position reveals that most adaptability dimensions do not significantly vary across positions. However, two dimensions—Explosive Performance Ability and Consistency in High-Intensity Skill Execution—do exhibit statistically significant differences, indicating that playing position has a distinct influence in these areas.

In Explosive Performance Ability, the variation in mean scores across positions is statistically significant ($F = 2.906$, $p = .030$), leading to the rejection of the null hypothesis. Centers recorded the highest mean (3.48), followed by point guards (3.30), while small forwards had the lowest score (3.03). This difference likely reflects the physical demands and positional expectations of each role. Centers, who often engage in vertical jumps, powerful post moves, and rapid rebounding actions, require and perhaps prioritize explosiveness more in their training. In contrast, small forwards may engage more in continuous, transitional movement rather than purely explosive actions, which could explain their lower score.

Consistency in High-Intensity Skill Execution also shows a significant difference across positions ($F = 2.852$, $p = .032$). Again, centers scored the highest (3.46), followed by point guards (3.40), while shooting guards reported the lowest mean (3.11). The ability to maintain high-intensity skill execution may relate to the repetition and role clarity inherent in a center’s position, whereas shooting guards, who frequently engage in unpredictable movement patterns and varied shot selection, might experience more variability in maintaining high-intensity output under pressure.

In contrast, the remaining indicators—Endurance Management ($p = .698$), Recovery and Readiness ($p = .745$), Role-Specific Skill Application ($p = .598$), and Movement Efficiency ($p = .781$)—do not show significant differences by position. These results suggest that foundational elements such as endurance, recovery, and role-

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specific preparation are perceived similarly by athletes regardless of their on-court roles. This could be due to uniform conditioning protocols or shared team-wide training strategies that aim to ensure baseline adaptability across the roster.

Although the overall adaptability mean varied slightly—ranging from 3.23 for small forwards to 3.39 for centers—the difference was not statistically significant (F = 2.358, p = .065). This implies that, in general, players across all positions maintain a comparable level of external training load adaptability, even though some positional-specific nuances exist.

In summary, Table 20 demonstrates that while most aspects of external training load adaptability are consistent across playing positions, significant differences arise in areas directly tied to physical intensity and explosive output. Centers, in particular, exhibit higher adaptability in these domains, which likely reflects the physicality and repetition inherent in their roles. These findings underscore the importance of customizing certain training elements—especially those related to explosiveness and sustained skill execution—according to the specific demands of each position to maximize player development and performance.

Table 21. Differences in the Assessment of the External Training Load Adaptability of the Selected Student-Athletes in terms of Average Weekly Training Hours

Indicator	**Average Weekly Training Hours**	**Mean**	**F**	**Sig.**	**Decision on Ho**	**Interpretation**
Endurance Management	Less than 5 5–7 8–above	3.36 3.39 3.41	.144	.866	Accepted	Not Significant
Recovery and Readiness	Less than 5 5–7 8–above	3.21 3.36 3.17	2.744	.073	Accepted	Not Significant
Role-Specific Skill Application	Less than 5 5–7 8–above	3.40 3.45 3.58	2.295	.110	Accepted	Not Significant
Explosive Performance Ability	Less than 5 5–7 8–above	3.28 3.21 3.23	.185	.831	Accepted	Not Significant
Consistency in High-Intensity Skill Execution	Less than 5 5–7 8–above	3.25 3.19 3.38	2.039	.140	Accepted	Not Significant
Movement Efficiency	Less than 5 5–7	3.06 3.21	1.368	.263	Accepted	Not Significant

	8–above	3.16				
Overall	Less than 5 5–7 8–above	3.26 3.30 3.32	1.202	.308	Accepted	Not Significant

As shown in Table 21, the assessment of external training load adaptability among the selected student-athletes based on their average weekly training hours reveals no statistically significant differences across all measured indicators. All p-values exceed the 0.05 threshold, leading to the acceptance of the null hypothesis in each case. This suggests that the amount of time student-athletes dedicate to training each week—whether less than five hours, between five and seven hours, or more than eight hours—does not significantly influence their adaptability to external training loads.

In the domain of Endurance Management, the mean scores across training hour groups are very similar: 3.36 for less than five hours, 3.39 for five to seven hours, and 3.41 for more than eight hours. With an F-value of 0.144 and a p-value of 0.866, the differences are negligible, indicating a uniform perception of endurance adaptability regardless of training duration.

For Recovery and Readiness, while those training five to seven hours weekly reported the highest mean score (3.36), followed by those training less than five hours (3.21) and those exceeding eight hours (3.17), the variation did not reach statistical significance ($p = 0.073$). Although this result is closer to the significance threshold, it still does not support a firm conclusion about training volume's effect on perceived recovery practices.

In Role-Specific Skill Application, the highest score was recorded by athletes training more than eight hours weekly (mean = 3.58), suggesting that more frequent training may support targeted skill refinement. However, the F-value of 2.295 and p-value of 0.110 indicate that this trend is not statistically robust and may be influenced by other factors such as coaching or individual commitment.

Explosive Performance Ability showed very little variation across groups, with mean scores ranging narrowly between 3.21 and 3.28. This, alongside an F-value of 0.185 and a high p-value of 0.831, reinforces that weekly training volume does not significantly shape perceptions of explosiveness adaptability.

Similarly, in Consistency in High-Intensity Skill Execution, although the highest mean was found among those training over eight hours per week (3.38), compared to 3.25 and 3.19 for the other groups, the difference is not significant ($p = 0.140$), suggesting that training frequency alone does not guarantee consistent high-intensity performance execution.

Movement Efficiency results also show minimal differences across groups, with mean scores hovering around the mid-3 range and a p-value of 0.263, again indicating no significant influence of training hours.

Finally, the overall external training load adaptability score shows a slight increase with training volume—3.26 for less than five hours, 3.30 for five to seven hours, and 3.32 for more than eight hours—but these differences are statistically insignificant ($p = 0.308$).

In summary, Table 21 illustrates that weekly training volume does not significantly impact how student-athletes perceive or manage their adaptability to external training loads. This suggests that factors such as training quality, specificity, coaching input, and individual responsiveness may be more critical than the sheer quantity of training time. Thus, optimizing training outcomes may depend more on personalized and targeted approaches rather than simply increasing training hours.

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

1. Profile of Respondents: The demographic and athletic background of the 60 student-athletes participating in the study revealed a diverse yet informative snapshot of the sample. The majority of respondents came from the 1st and 3rd academic years, representing 33.3% and 31.7% respectively, indicating that younger and mid-level college athletes made up most of the group. In terms of competitive experience, a large portion had either less than one year (40.0%) or more than three years (35.0%) of playing basketball, suggesting a mix of novice and seasoned athletes. Playing positions were evenly distributed, with point guards making up the largest proportion (23.3%) and centers the smallest (15.0%). In terms of training commitment, nearly half (45.0%) of the athletes trained for more than eight hours weekly, showing a high level of dedication to their sport. This varied profile provides a solid base for analyzing adaptability across different constructs and demographic groups.

2. Assessment of the Internal Training Load Adaptability of the Selected Student-Athletes: Internal training load adaptability was assessed through four key constructs: sleep quality and duration, psychomotor speed, training impulse, and perceived exertion. All constructs yielded weighted means within the “Agree” range, categorized as “Adaptable.” Perceived Exertion emerged as the strongest construct (mean = 3.43), highlighting the athletes’ capacity to interpret and respond to effort during training. Sleep Quality and Duration closely followed (mean = 3.41), reflecting a good understanding of the role of rest in performance. Psychomotor Speed (mean = 3.24) and Training Impulse (mean = 3.23) scored slightly lower, suggesting moderate adaptability and potential gaps in cognitive reaction training and the technical application of training intensity monitoring. Overall, these results portray a well-rounded but improvable level of internal load adaptability.

3. Differences in Profile – Assessment of Internal Training Load Adaptability: Statistical analysis revealed that year level and playing position had no significant influence on internal training load adaptability across any of the constructs, indicating that adaptability traits were consistent regardless of academic standing or role on the court. However, years of competitive experience revealed significant differences in Psychomotor Speed, Training Impulse, and Perceived Exertion. Interestingly, athletes with less than one year of competitive experience consistently reported higher adaptability scores. This trend may reflect heightened motivation, recent exposure to structured training, or more optimistic self-perceptions among newer athletes, compared to more experienced players who may face cumulative training stress or plateauing performance. These findings suggest that adaptability may initially be more perceptual and decrease as competitive intensity and fatigue increase with experience.

4. Assessment of the External Training Load Adaptability of the Selected Student-Athletes: External training load adaptability was evaluated across six constructs: Endurance Management (mean = 3.39), Recovery and Readiness (3.23), Role-Specific Skill Application (3.49), Explosive Performance Ability (3.24), Consistency in High-Intensity Skill Execution (3.29), and Movement Efficiency (3.14). All constructs were rated as “Adaptable.” Role-Specific Skill Application ranked highest, showing athletes’ clear understanding of how to align technical skills with positional demands. Endurance Management was also strong, indicating confidence in sustaining performance over time. On the lower end, Movement Efficiency was the least developed, suggesting a lack of emphasis on biomechanics and efficient movement strategies. These results suggest that while athletes perform reasonably well in aligning physical output to external demands, targeted improvements in explosiveness and movement mechanics could enhance their overall adaptability.

5. Differences in Profile – Assessment of External Training Load Adaptability: Differences in external training adaptability were most evident when examined by years of competitive basketball experience. Significant differences were found in Endurance Management, Role-Specific Skill Application, Explosive Performance Ability, and overall adaptability, with newer athletes consistently scoring higher than their more experienced peers. This might reflect greater enthusiasm or more recent exposure to structured training frameworks. Playing position also influenced results, particularly in Explosive Performance Ability and Consistency in High-Intensity Skill Execution, where centers outperformed other positions—likely due to the high physicality and repetition in their roles. However, no significant differences were observed in adaptability when analyzed by year level or

average weekly training hours, suggesting that training duration and academic standing alone are not strong determinants of adaptability. These insights emphasize the need for personalized training strategies that consider competitive experience and positional demands rather than relying solely on generic training volume or academic progress.

Conclusion

1. The profile of the respondents confirms a balanced representation of student-athletes with varying levels of academic standing, playing experience, and training exposure. This diverse composition—dominated by 1st and 3rd year students, a mix of novice and experienced athletes, and a broad distribution across playing positions and training loads—provides a robust foundation for analyzing the multifaceted nature of training load adaptability.

2. Student-athletes demonstrate a moderately high level of internal training load adaptability, with strengths in perceived exertion and sleep quality, but with room for growth in psychomotor speed and training impulse. The results reveal that while athletes are generally competent in self-regulating effort and rest, there is a need for improved cognitive response strategies and greater use of physiological feedback to optimize training outcomes.

3. Adaptability to internal training load is significantly influenced by the athletes' years of competitive experience, but not by academic level or playing position. Less experienced athletes scored higher in several adaptability measures, suggesting that perceptions of adaptability may decline with prolonged exposure to training stress or due to diminished novelty and motivation, highlighting the need for renewed engagement strategies among veteran players.

4. External training load adaptability is generally well-established among the athletes, with particularly strong performance in role-specific skill application and endurance management. However, areas such as movement efficiency and explosive performance remain less developed, pointing to the importance of refining biomechanics and integrating more power-oriented drills into training programs to support long-term athletic performance.

5. Playing experience and position significantly influence external training load adaptability, especially in explosiveness, endurance, and high-intensity execution, whereas academic year and training hours do not. These findings emphasize that physical roles and cumulative competition exposure more accurately reflect differences in adaptability, and thus should guide individualized training and recovery protocols.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed to enhance the internal and external training load adaptability of student-athletes:

1. Develop and implement individualized training programs tailored to competitive experience and playing position. Given that adaptability levels vary significantly with experience and role, training plans should address specific needs such as explosiveness for centers, endurance for guards, or cognitive drills for newer players to build psychomotor speed.

2. Integrate regular monitoring and feedback systems into training to support data-driven adaptations. Athletes should be encouraged and equipped to monitor key performance indicators such as heart rate, perceived exertion, sleep quality, and movement efficiency using accessible tools. This will enhance self-awareness and allow for timely adjustments to workload.

3. Reinforce recovery education and practical strategies, especially among experienced athletes. Recovery and readiness, while rated as adaptable, showed signs of inconsistency. Emphasis should be placed on sleep hygiene, nutritional practices, active recovery, and psychological strategies to maintain performance sustainability across prolonged training cycles.

4. Strengthen explosiveness and movement efficiency components in conditioning programs. Since these were identified as weaker areas, strength and plyometric training, along with movement analysis and sport-specific drills, should be embedded into team routines to improve rapid performance output and biomechanical effectiveness.

5. Promote reflective practice and structured skill review routines. Encouraging athletes to regularly evaluate their role-specific skill application and to seek and apply feedback will promote greater technical consistency and long-term adaptability, particularly under high-intensity conditions.

6. Ensure that training volume is accompanied by quality and specificity. While weekly training hours did not significantly influence adaptability, quality-focused sessions that align with game demands, recovery needs, and individual performance goals are more effective than increasing time alone.

7. Provide targeted support for experienced athletes to maintain motivation and prevent performance plateaus. Mental fatigue and training monotony may reduce adaptability in long-term athletes. Incorporating variety, goal-setting, and recovery-focused coaching can help sustain their competitive edge and training engagement.

Output Of The Study

Basketball Training Plan

Rationale

This intervention plan was developed in response to the key findings of the study on the internal and external training load adaptability of selected student-athletes. The results revealed that while overall adaptability was rated as "Adaptable," certain critical areas consistently showed lower mean scores, indicating opportunities for targeted improvement. These areas include movement efficiency, monitoring of explosive performance, responsiveness to recovery status, reflective skill application, and communication of perceived exertion—each of which plays a pivotal role in athletic development and performance sustainability.

Lower scores in movement efficiency suggest that athletes may not be optimizing biomechanics, leading to unnecessary fatigue and reduced performance longevity. Similarly, the lack of explosive performance monitoring points to a gap in individualized power training and tracking, which is essential for enhancing short bursts of athletic output. Furthermore, many athletes were found to have limited ability to adjust training based on recovery, indicating the need for education and tools that support self-regulation and prevent overtraining.

In terms of reflective skill application, results show a lack of structured self-assessment practices that are crucial for positional awareness and targeted skill refinement. Lastly, limited communication of perceived exertion between athletes and coaches implies a need to strengthen feedback loops that enable effective training intensity adjustments.

By addressing these lowest-performing areas through specific, measurable, and time-bound activities, this intervention plan aims to improve overall training adaptability, reduce injury risk, and support more personalized and effective coaching strategies. The integration of athlete-centered tools, consistent monitoring, and educational support ensures that adaptability is developed not only physiologically, but also cognitively and behaviorally, leading to more resilient and performance-ready athletes.

Key Result Areas (KRA)	**Objectives**	**Activities**	**Persons Involved**	**Performance Indicators**	**Timeframe**	**Budget (IN Yuan)**
Movement Efficiency	Improve athletes' biomechanical movement	- Conduct movement analysis sessions	Coaches, Strength & Conditioning	Movement analysis reports; improved form; reduction in	3 months	¥8,000

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	to enhance efficiency and reduce fatigue.	- Integrate sport-specific movement drills into training - Host workshops on functional movement - Use video feedback for form correction	Coaches, Athletes	fatigue-related complaints		
Monitoring Explosive Performance	Encourage athletes to track explosive performance to tailor training load.	- Introduce jump/sprint testing tools - Train athletes in using monitoring apps - Schedule monthly explosive testing - Provide individual performance dashboards	Coaches, Athletes, Sports Scientist	Testing participation rate; improvement in explosive metrics over time	2 months	¥14,000
Adjusting Training Based on Recovery	Improve athletes' responsiveness to recovery status in modifying workload.	- Implement daily readiness surveys - Monitor sleep and soreness ratings - Integrate recovery tech (e.g., heart rate variability apps) - Educate athletes on self-regulation techniques	Coaches, Athletes, Trainers	Athlete-reported recovery scores; training plan modifications logged	3 months	¥13,500

Reflective Skill Application	Foster athlete self-evaluation to improve position-specific performance.	- Introduce skill journals - Facilitate monthly reviews with coaches - Use video self-assessment tasks - Encourage peer feedback sessions	Coaches, Athletes	Frequency of journal entries; quality of reflection; skill improvement observed	3 months	¥8,000
Communication of Perceived Exertion	Promote athlete-coach communication regarding training intensity.	- Standardize RPE use post-training - Use digital or printed feedback forms - Hold brief post-training discussions - Conduct RPE education sessions	Coaches, Athletes	RPE form usage rate; frequency of coach adjustments based on feedback	1 month trial	¥8,500

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