THE INFLUENCE OF LIBERO PLAYERS ON TEAMMATE PHYSICAL PERFORMANCE IN SIMULATED MATCHES: A CASE STUDY OF AMATEUR VOLLEYBALL ATHLETES

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อิทธิพลของผู้เล่นตำแหน่งลิเบโร่ต่อสมรรถนะทางกายของเพื่อนร่วมทีมในแมตช์จำลองการแข่งขัน: กรณีศึกษาของนักกีฬาวอลเลย์บอลสมัครเล่น

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BY

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HAS BEEN APPROVED BY THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT
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This study aimed to analyze the influence of libero players on the physical performance and mental workload of their teammates in a simulated volleyball match. The sample consisted of 12 male amateur volleyball players from a university in Yunnan Province, China. A crossover randomized controlled trial was used to compare the results in four competition conditions, each with or without a libero on each team. The variables studied were average heart rate (HR), percentage of maximum heart rate (Percentage HR), rate of perceived exhaustion (sRPE), mental workload (NASA-TLX), and countermovement jump (CMJ) height. The results showed that, the non-libero group had a significantly higher mean HR (162.18±5.79 bpm) compared to the libero group (149.79±9.18 bpm) with $p = 0.023$, as well as a higher Percentage HR (80.85±2.92% vs. 75.34±5.20%, $p = 0.030$), as well as sRPE (7.90±0.72 vs. 6.50±0.88, $p = 0.001$) and NASA-TLX (52.95±3.86 vs. 42.75±4.04, $p = 0.001$). In terms of CMJ, post-match values were significantly lower within each group ($p < 0.05$), but there was no difference between the groups ($p = 0.145$). The results of the study showed that libero players play an important role in reducing the physical and mental burden on other players on the team, especially in reducing heart rate and fatigue. Both physically and mentally, the use of a libero should be considered as part of team strategy for amateur competitions.

Keyword : Workload, Physical performance, Volleyball, Libero

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CHAPTER 1

Introduction

Background

"LIBERO" is a rule introduced by FIVB in the 1996 World Volleyball Grand Prix, called Libero Defensive Player. The function of the Libero Defensive Player is to strengthen the defense to achieve the effect of balancing the offense and defense. (FIVB Rules, 2021) The Libero Defensive Player is a special role in volleyball, mainly responsible for defense and serve receive. Libero usually had excellent defensive skills and quick reaction ability. their presence can greatly improve the team's defensive ability and reduce the opponent's scoring opportunities. The importance of liberos in the game is that they can provide more offensive opportunities for their teammates and relieve the pressure of other players on defense (Rentero et al., 2015).

Amateur athletes are athletes who do not participate in sports as a career and do not rely on participation for a living income. Amateur athletes are not employed by professional sports clubs and train and compete on their own, or with the help of social organizations or government agencies. Amateur athletes participate in sports competitions based on their own interests, the pursuit of sportsmanship, or to win honors for their community organization or country. Amateur athletes can only get limited prizes or awards for their participation, so amateur athletes may have their own jobs and just train and compete in sports after work. having Libero allows the team to be more diverse in defensive tactics. They can flexibly fill positions and form an effective blocking system with other players. In attacking tactics, the Libero high quality pass also provides a guarantee for the implementation of various complex tactics. the stable play of Libero in the back row can bring a sense of security to teammates, reduce the anxiety level of players, and enhance the self-confidence of the team. For example, a great save by a Libero at a crucial score might be a great morale boost for his team mates. Teams with a libero often experience shorter rally durations in their favor, due to more successful transitions from defense to offense and quicker execution of attacking plays (Marra et al.,

2019). Performance Under Pressure: Amateur players with a libero on the team are better able to perform under pressure, especially in tight situations, as the libero's presence in the backcourt provides a sense of security (Lin, 2014).

The libero plays an important role in amateur volleyball:

1. The libero mainly undertakes the task of back row defense. They have a strong defensive ability, can move quickly to the ball near the landing point, save those strong dunk, tricky hanging ball, etc., In the face of a strong receiver's slash and dunk, the libero can defend effectively with quick lateral movement and excellent judgment.

2. The libero can play the role of making up for the vacancy in defense. When other players are attacking or blocking in the front row, the libero can fill up the vacancy in defense in the back row very well. Because in volleyball, the front and back row players need to change positions often, the existence of the libero can ensure that the back row always has a stable defensive force.

3. The libero is an important part of the team's passing system. They have delicate skills, and they are able to pick up the ball more stably when receiving the serve, creating better conditions for the second passer to organize the attack. In some key points of the serve receiving link, the coach often trusts the libero passing ability more. Blocking Efficiency. Although the libero does not participate in blocking, their defensive coverage behind the block allows frontcourt players to block more aggressively, knowing that the libero is covering the open spaces (Isabel et al., 2007; Zetou, 2007).

4. In simulated games, teams with a libero demonstrate superior defensive performance, including more successful digs and quicker transitions from defense to offense, as compared to teams without a libero (Palao et al., 2004).

The comprehensive ability of volleyball players includes physical quality, technical quality, psychological quality and tactical quality. Among them, the physical quality of athletes has a significant impact on the athlete's own skills and the team's tactics. Therefore, athletes must have the physical quality that meets the requirements of this sport (Taware et al., 2013).

Physical performance of volleyball players: In volleyball games, athletes use their body shape (height, weight, BMI), physiological function (cardiopulmonary, load), and athletic quality to coordinate and operate in a comprehensive way to meet the requirements of "high intensity, multiple movements, and repeated jumps" in volleyball games (Sousa et al., 2023). In terms of body shape, the advantages of height and arm span are conducive to spiking and blocking, and a reasonable muscle-to-fat ratio (BMI) can improve exercise efficiency; in terms of physiological function, a strong cardiovascular system guarantees oxygen supply in long-term high-intensity confrontation, and the nervous system ensures agile response to the fast-changing game situation. Athletic quality is crucial in volleyball games: in terms of strength, the main attacker and the secondary attacker need to have excellent jumping explosive power and continuous jumping ability to complete spiking and blocking; the libero is reflected in quick reaction and movement on the court, which is convenient for timely receiving and defense; endurance requires athletes to maintain their condition in multiple rounds of offense and defense; sensitivity and flexibility help athletes make unconventional movements while reducing the risk of injury. These physical elements cooperate with each other and become a solid foundation for athletes to steadily display their skills and execute tactics (Forthomme et al., 2005).

For amateur volleyball players, their performance may be different in simulated matches with and without a free man. The purpose of this paper is to analyze the performance of amateur volleyball players in simulated matches with and without a free man by conducting experiments to explore the performance of amateur volleyball players in simulated matches with and without a free man to provide a reference basis for amateur volleyball players' matches .Game Pace and Transitions， The presence of a libero tends to quicken defensive transitions, allowing for smoother transitions into attack. This is a crucial aspect of modern volleyball, as defensive transitions can significantly affect match outcomes (Zetou, 2007). The libero can enhance overall team cohesion in defense by providing stability and reducing pressure on other players in the backcourt. This often leads to a more structured and predictable defense (Marra et al., 2019).

The libero dynamics are therefore of interest in studying amateur athletes as the effects they can have on their performance may or may not be on their team, and may also affect their physical performance and overall load on other players. The focus of this study was to examine these effects using a simulation of a competitive situation in a group of amateur volleyball players.

Purpose of the study

To assess the performance and physiological responses of amateur volleyball athletes in a simulated game with and without the libero.

Importance of the study

1.By studying the differences in the performance of different players in matches with and without libero, it is possible to better understand the strengths and weaknesses of each player, so as to more accurately arrange the players' positions in matches and bring out the maximum potential of each individual.

2.To provide amateur teams with a basis for tactical choices in different game situations. The results of the study will allow teams to make more informed decisions about whether to use libero and how to adjust tactics when facing different opponents and game scenarios.

Scope of the research

Populations

Amateur volleyball players in Yunnan Province, 24 amateur volleyball players (non-sports majors) were recruited from 12 higher vocational universities under the jurisdiction of Kunming, Yunnan Province, for the study.

Participants

In this study, 12 players were randomly selected from the whole team based on International Volleyball Federation (FIVB) (Official Volleyball Rules 2021, International Volleyball Federation (FIVB)), and previous studies in the field, with an effect size of 0.75 (García-de-Alcaraz & Usero, 2019), and a statistical power of 0.80. They were taking part

in training, and the sample was randomly divided into two groups, group A 1,3,5,7,9,11; Group B 2,4,6,8,10,12.

Variables of the study

independent variables

Simulation of Volleyball competition that wit and without libero 4 games.

Match 1

Volleyball game simulation Team A with a libero vs Team B without a libero.

Match 2

Volleyball game simulation Team A without a libero vs Team B with a libero.

Match 3

Volleyball game simulation Team A with a libero vs Team B with a libero.

Match 4

Volleyball game simulation Team A without a libero vs Team B without a libero.

Dependent variables

Heart rate (HR)

Average HR (AvrHR)

Measured continuously during the game with a heart rate monitor.

Percentage HR (PHR)

The percentage of heart rate during the race is based on the maximum heart rate using 220-age.

Lower muscle power test

Tested pre- and post-game using a counter movement jump (CMJ) to assess lower body power.

Rate of perceived exertion

Assessed immediately after each set using the sRPE (0-10).

Mental workload

The NASA Task Load Index (NASA-TLX) measured post-game to evaluate the subjective cognitive load.

Definition of specific terms

Heart rate

The heart rate is a measure of the number of times a person's heart beats per minute, usually referred to as the heart rate generally refers to the quiet heart rate, i.e., awake, not involved in the activities of the quiet state, the number of heart beats per minute. It is one of the basic indicators for assessing heart function. Adults in the quiet state of the heart rate is generally 60 ~ 100 beats / min, can be due to age, gender or other physiological factors produce individual differences, cardiorespiratory fitness of athletes will usually be lower than the average person's heart rate.

Average heart rate (AvrHR) and Percentage HR (PHR)

Average heart rate (AvrHR) refers to the average number of heart beats per minute over a period of time (such as a few minutes, hours, a day or a longer period). It reflects the overall activity intensity of the heart during that period of time. Percentage HR (PHR) refers to the ratio of the current heart rate to a certain "maximum heart rate" or "target heart rate", usually expressed as a percentage, which is used to quantify the intensity of the heart rate relative to a reference value.

Rate of perceived exertion (RPE)

The RPE (Rating of Perceived Exertion) is a subjective measure of exercise intensity, through the subjective self-feeling to assess the intensity of exercise. It was created by the Swedish physiological psychologist Gunnar Borg in the 1970s, mainly used to monitor the intensity of exercise, to prevent damage to the body's functional system. RPE intensity measurement table is a simple and easy to use self-perceived intensity assessment tool, which can help people better grasp the intensity of the exercise and fatigue, so as to carry out exercise training in a more scientific way.

Lower muscle power test

The Lower muscle power test is one of the most popular tests for monitoring athletes' lower extremity muscle strength. In this research, the counter movement jump

test (CMJ) was used as an assessment. Athletes' Lower muscle power test performance is associated with a variety of sports, and they are recognized as indicators of vertical jump performance and are used to measure training adaptations and monitor neuromuscular fatigue. Lower muscle power test it is about assessing and quantifying an individual's explosive power and lower body strength. By measuring parameters such as jump height the Lower muscle power test, it is possible to objectively evaluate an individual's lower extremity explosive power and muscle strength, providing a scientific basis for training and rehabilitation.

NASA-TLX

The National Aeronautics and Space Administration (NASA) Task Load Index (NASA-TLX) is a widely used tool for assessing perceived workloads in a variety of areas (Coelho et al., 2014; T. Mullen et al., 2021), including sports. While it was originally designed for aerospace tasks, its adaptability makes it effective for evaluating cognitive and physical workload in sports contexts. In this study, the loads generated in competitive games with and without libero players were assessed.

VO_2max

VO_2max Y0-Yo 1R1. Yoyo Interval Recovery Test Level 1 (YYIR1) is a commonly used physical fitness test for team athletes. Participants run back and forth on a 20-meterlong track, taking a 10-second break between each run. The required running speed gradually increases until they can no longer run. The results of this test are correlated with aerobic fitness scores and can be converted into VO_2max scores. You can use our calculator to calculate VO_2max, or use a conversion table based on the same formula (Bangsbo et al., 2008), which is:

$$VO_2\text{max (ml/min/kg)} = \text{distance run (m)} \times 0.0084 + 36.4$$

Physical performance

Physical performance: a comprehensive reflection of the synergistic effects of an athlete’s body shape, physiological function and athletic qualities in a volleyball scenario. In this study, physical performance measures included the Lower muscle power test, which is an important performance in volleyball athletes.

Research conceptual framework

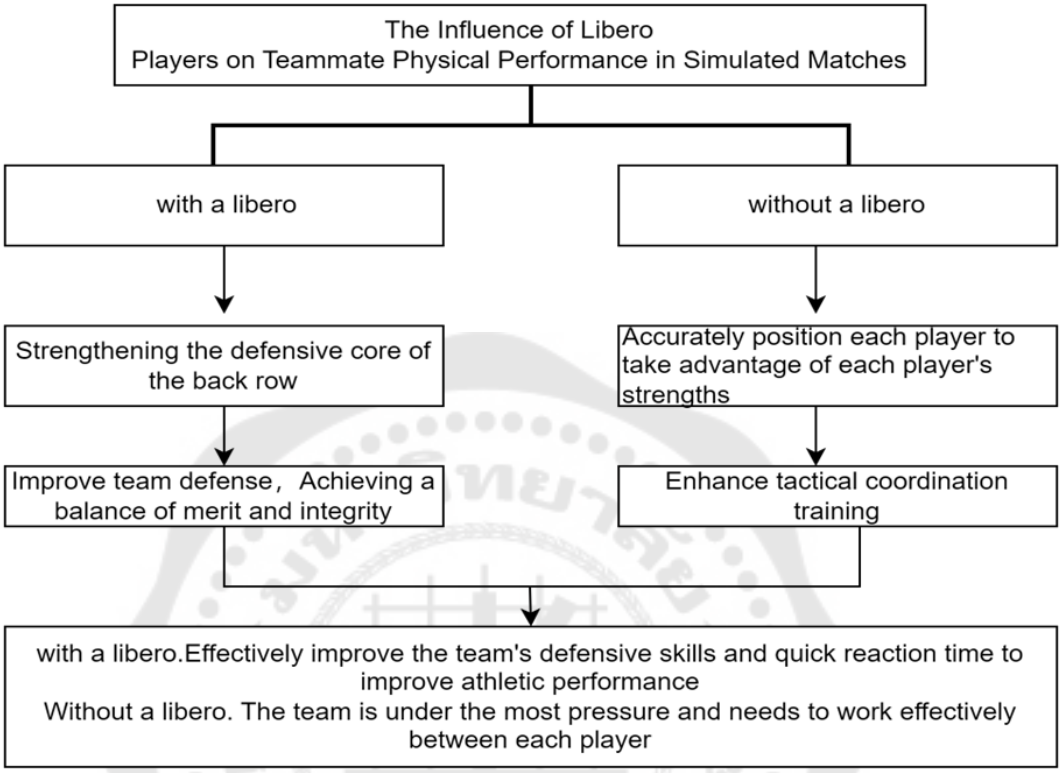


FIGURE 1 Research conceptual framework

Research hypothesis

Teams that have a libero player during the match will have different physical fitness when compare with teams that do not have a libero player.

CHAPTER 2

Literature Review

In this research, the researcher reviewed documents and related research, presenting the following topics:

1. Studies related to the role of libero in volleyball games
2. Research related to the characteristics of amateur volleyball players
3. Research on the impact of having with a libero and without libero on amateur volleyball games

Studies related to the role of libero in volleyball games

Volleyball has seen major changes in all aspects of its history, including rules, techniques and tactics. However, one major change in the last 20 years has been the introduction of the libero (LIBERO), who specializes in serve receive and defense. In volleyball, the role of the libero is more specialized than other roles, thanks to the individual fundamentals of the libero as well as the team fundamentals of receiving and defending.

Singh et al. (2021) The libero is a player who specializes in defense, wears a different uniform from the other players, is in the back row, and is not allowed to complete an offensive shot if the ball is completely above the net when it touches the ball. Players in this position are usually responsible for receiving serves, swinging the ball, and passing the ball so that teammates can use these passes to turn them into effective offense. The libero needs to have good passing, stealing, ball control skills, and be fast and stable. In a game, the libero can sometimes be the turning point of the game. Many factors will affect the performance of the libero in the game, including his physical characteristics, technical ability, psychological toughness, etc.

The libero has an important influence on the game of volleyball. During the game, the libero helps to improve the efficiency of defense and usually plays a role in balancing the offense and defense of the game. Firstly, Study the impact of the libero on high-level volleyball was explored (Cartagena Durán, 2019). Four matches from the final and semi-final of the 2018 World Volleyball League were recorded. The results showed

that: liberos generally work in a balanced way in this important men's volleyball tournament. In professional men's volleyball, the introduction of the libero system has helped to increase the efficiency of the defense and therefore balanced the offensive and defensive phases of the game. Likewise, examined that modern volleyball is characterized by a significant increase in offensive power and rule changes that have strengthened defensive support (Merghes & Gradinaru, 2014). This also explains the emergence of the libero (LIBERO) whose use is not mandatory. In this paper, the physical characteristics of the “LIBERO” were constructed by recording the parameters of the players who played the position of “LIBERO” in the team that participated in the Summer Olympic Games in London in 2012. The subjects of the study were the liberators of the 12 volleyball teams that qualified for the Games. The following parameters of these players were recorded: age, height and weight. The study showed that the age of the liberators in the studied volleyball teams was relatively high (more than 30 years old), which indicates that they have gained a lot of experience during their long volleyball training.

The role of libero in volleyball requires higher professionalism and skills than roles in other positions. Studied Longitudinal case study of the role of libero in volleyball (Marra et al., 2019), in volleyball, the role of the libero has a higher degree of professionalism compared to other roles, thanks to his or her individual dunking fundamentals and the team-wide catching and defending fundamentals. The results of the tests show that continuous training is the key to winning in sports, especially in volleyball, and especially for the libero player: in fact, this role requires a higher level of skill than the other roles. Likewise, the study analyzed the participation of the libero in the offensive and defensive phases of men's good volleyball and its impact (Rentero et al., 2015). The study sample consisted of 1101 passing and defensive game actions of the top four ranked teams in the 2008 Beijing Olympics. Study variables included team classification, receiving/defensive players, passing/defensive zone, passing/defensive efficiency, second pass efficiency, attacking/rebounding zone, attacking/rebounding time, and attacking/rebounding efficiency. The results of the study showed that there was a significant association between defensive players and defensive phases of the game, with

free agent defense dominating zone 5; a significant association between defensive players and defensive efficiency, with free agent defense increasing defensive efficiency; and a significant association between defensive players and counterattacks, The number of fouls in Zone 6 has increased when defending a libero.

In this study, it was concluded that in the U-19 men's group, the involvement of the libero differed between the attacking and defensive phases, and the areas where the libero's involvement increased significantly, namely the receiving and defensive phases, were: receiving in the long zone and line six; defending in the middle zone and line five. Therefore, during training, it is recommended to separate the libero's functions in the attacking and defensive phases and to conduct exercises that are as similar to game scenarios as possible. The libero's influence was greater in the defensive phase than in the offensive phase. Thus, in the receiving phase, his involvement increased the attack from the best zone. During the defensive phase, his participation led to perfect defense, from the optimal area to the third area, as well as quick counterattacks. These results indicate that the goal of the rule change aimed at introducing free players has been achieved at this level. In the existing literature, we have found several studies on free players, most of which were conducted at a high level. Moreover, these studies analyzed the influence of free players during the receiving, serving, or defensive phases, and the results were sometimes inconsistent. Therefore, this study aims to determine the participation and influence of free players in the sideline defense and counterattack phases of young volleyball players (Sánchez et al., 2019).

In this study, the conclusion was drawn that in the U-19 men's group, the participation of a libero differed in the offensive phase and the defensive phase. The areas where the participation of a libero significantly increased, namely the receiving and defensive phases, specifically included: receiving in the long area and the sixth defense line; middle zone and line five defense. Therefore, during training, it is suggested that the duties of the libero in the offensive and defensive phases be separated, and training should be conducted as closely as possible to the actual game scenarios. The libero's influence in the defensive phase was greater than in the offensive phase. Therefore, in the

receiving phase, his involvement increased the attack from the best area. In the defensive phase, his involvement created perfect defense, attacks from the best area to the third area, and fast attacks. These results indicate that at this level, the goal of introducing the libero as a rule change has been achieved. The Studies related to the role of libero in volleyball games can be studied in the following research summary table 1.

TABLE 1 The studies investigating the studies related to the role of libero in volleyball games.

Citation	Title	Purpose	Conclusion
Singh et al. (2021)	Prediction of the performance of libero (defensive midfielder) based on the selected physical characteristics.	This study aims to predict the performance of Libero based on the selected human measurement characteristics.	This kind of performance is related to the human body measurement characteristics. It can be used to assess Libero's performance more comprehensively.
Cartagena Durán (2019)	The influence of freestyle swimming on high-performance volleyball.	Purpose: To determine the impact of the libero on elite volleyball performance.	The libero is the person who mainly participates in defense and receiving serves during the game.
Merghes & Gradinaru (2014)	Comparative Analysis of "The Great 'Liberators'" Performance Volleyball	the "free players" from 12 volleyball teams that were eligible participate in the competition.	the 2012 Summer Olympics in London are equipped with one libero, while the Italian team has two.

TABLE 1 (continued).

Citation	Title	Purpose	Conclusion
Marra et al. (2019)	Longitudinal case study of the role of libero in volleyball	The libero's basic personal efficiency during the game: free throws, receiving the ball and quick defense.	In volleyball in particular, consistent training is the only key to victory, especially for libero: in fact, this role requires a higher level of skill than others, almost perfect.
Rentero et al. (2015)	analysis of the libero's influence in different match phases in volleyball	The aim of the study was to analyse the libero's participation and their influence.	In professional men's volleyball, the introduction of the libero helps improve defensive efficiency, thus balancing both the offensive and defensive sides of the game.
Sánchez et al. (2019)	Participation and influence of the libero in reception and defense, in volleyball U-19	The study was to determine the participation and influence of the libero in both the side-out and counter-attack phases.	Free agents have a greater impact on the defensive phase than on the offensive phase. The goal of introducing free agents as a regulatory change has been achieved.

Relevant research on the characteristics of amateur volleyball players

For amateur volleyball players, amateur athletes have lower technical proficiency (e.g., poor stability in passing and dunking), are prone to self-doubt due to errors during the game, and have reduced decision-making ability to cope with changes on the court. Amateur volleyball players lack experience in official matches and are fearful of unknown factors such as the atmosphere of the court and the intensity of the opponent. This anxiety may be more pronounced due to their non-professionalism and less match experience.

Competition anxiety is one of the psychological factors that affect an athlete's performance. However, there is no consensus yet on the perception of volleyball competition anxiety and the influence of gender variables. From the previous studied (Silva et al., 2023) to determine the most frequently perceived anxiety dimensions (cognitive anxiety, somatic anxiety and self-confidence) among amateur volleyball players in terms of intensity, direction and frequency of responses; (2) To analyze the influence of the gender variable on the perception of anxiety dimensions. 62 amateur volleyball players, 25 males and 37 females, took part in the study and competed in the Intermunicipal Volleyball Championships, this is a qualifying round. The three dimensions used to measure anxiety: cognitive anxiety, somatic anxiety and self-confidence. It was concluded that among amateur volleyball players, the anxiety dimension they perceived the most was self-confidence.

Amateur volleyball players are often easily affected by psychological factors during the game. Due to the lack of rich game experience, they are prone to tension and anxiety when facing pressure, which affects their technical performance. Study and Research probe analyzed the main factors that motivate amateur volleyball players and determined whether there are gender differences in these factors (Aniszewski et al., 2024). The sample consisted of 200 athletes from amateur teams in the adult division of the Rio de Janeiro State Volleyball League, with a mean age of 26.5 ± 5.5 years, 100 males (25.8 ± 5.4 years) and 100 females (27.1 ± 5.6 years). The Participation Motivation Questionnaire (PMQ), adapted to the Brazilian context, was used in this study. The results showed that belongingness, health, technological advancement and physical fitness were

the most important factors for participants. Thus, intrinsic self-regulatory motives dominated, which helped athletes to maintain a lasting connection with physical activity. Secondly, the athletic performance of amateur volleyball players may be influenced by a number of dimensions such as the athlete's own condition, lack of training methods (technical and tactical), and psychological state. In the study the relationship between the type of conceptual representations and team efficiency and sport performance of amateur and professional volleyball players was explored (Soflu & Esfahani, 2011). The statistical population consisted of players from eight teams participating in the 2010 season of the Volleyball Super League. The instruments used in this study included the Sports Representations Questionnaire (SIQ, which contains five micro scales including specific representations, general representations, specific motivational representations, skill representations, and arousal representations), The results of the study indicated that both professional and amateur sports groups used the skill representation (MG-M) more than the other groups. Furthermore, there was a significant difference in group efficacy between amateur and professional volleyball players (p-value < 0.001 and F = 21.45).

Amateur volleyball players usually focus on their studies or work, and can only use their spare time for training. The training time is irregular, short, and unfixed, making it difficult to ensure the intensity and frequency of training, which is not conducive to the continuous improvement of their technical level and physical fitness. Amateur volleyball players are relatively lacking in competition experience, have few opportunities to participate in formal competitions, have little experience in competing with high-level opponents, and have relatively weak adaptability and control over the rhythm of the game. In the face of the intense competition atmosphere, they are prone to mistakes. Previous studied that explored internal loads in men's professional volleyball (Pisa et al., 2022), the objectives of the systematic review were (a) to integrate the values of internal loads in volleyball presented in the literature; (b) to validate the applicability of different tools to quantify and monitor these variables; and (c) to analyze their similarity with match and training loads. The most common and effective tools for quantifying, monitoring and evaluating the internal load of volleyball are the Rating of Perceived Exertion (RPE), the

Rating of Perceived Exertion during Training Sessions (sRPE), and other indicators derived from these data. The volleyball training sessions range from 4 to 7 on the Brog scale, with more jumps indicating a greater load. Conclusion: In professional men's volleyball teams, the training load seems to be planned according to the season cycle and different dates within the week. Intra-week load dynamics are essential for proper recovery and adaptation of the athlete to volleyball training, while the increase in inter-week load can be monitored by ACWR. By studying literature (Darya, 2024) The research results of the Experimental Study on the Psychological Characteristics of Male and Female Amateur Volleyball Teams demonstrate the outcomes of an experimental study aimed at examining the psychological characteristics of male and female amateur volleyball players. volleyball teams. The study included team interaction, Player motivation, leadership style, team spirit level, and gender all have an impact on these factors. The total number of participants in this study sample was 14. The research found that people with strong adaptability often feel a strong sense of unity during group communication. The Research related to the characteristics of amateur volleyball players can be studied in the following research summary table 2.

TABLE 2 The studies investigating the Research related to the characteristics of amateur volleyball players.

Citation	Title	Purpose	Conclusion
Aniszewski et al. (2024)	Motivational factors for adult amateur volleyball athletes.	To investigate the main factors that motivate amateur volleyball players.	The factors that practitioners are most concerned about are a sense of belonging, health, technological progress and physical condition.
Silva et al. (2022)	The pre-match anxiety of amateur volleyball players.	Identify the most common anxiety dimensions among amateur volleyball players in terms of intensity, direction, and frequency.	Among the three reaction dimensions, the anxiety dimension that the amateur volleyball players perceived to be the most intense was self-confidence.
Soflu et al. (2011)	The relationship between the concept images of amateur and professional volleyball players, team efficiency and performance.	The investigation focused on the relationship between conceptual imagery types and team efficacy and performance among amateur and professional	There is a significant difference in the therapeutic effect between amateur volleyball players and professional volleyball players.

TABLE 2 (continued).

Citation	Title	Purpose	Conclusion
Pisa et al. (2022)	Internal load in male professional Volleyball: A systematic.	The indicators for evaluating the internal load of volleyball include rated perceived exertion (RPE) and score of perceived exertion during training (sRPE). these data.	Dynamic changes in intraweek load are necessary for athletes to recover and adapt to volleyball, and increases in intraweek load can be monitored through the ACWR.
Darya et al. (2024)	Experimental study of psychological features of women's and men's amateur volleyball teams	This study presents the results of an experimental research aimed at examining the psychological characteristics of male and female amateur volleyball teams.	There are significant differences in psychological characteristics and motivational factors between male and female amateur volleyball players aged 18 to 25 years.

Research on the impact of having with a libero and without libero on amateur volleyball games

The libero was introduced in 1998 to improve a team's receiving and defensive abilities. Improving the fundamentals of receiving helps the offense, which is the most important fundamental skill for a volleyball team to win (Bozhkova, 2013). While the importance of the libero in improving receiving ability at a high level of volleyball is self-evident, it is important to determine whether the libero at a high level of volleyball can improve this fundamental skill during competition. (Junior, 2014) Following this review also showed that the libero (percentage of reception efficiency = 77.91% and 33.67±35.6 errors) is better at reception than the wing player (percentage of reception efficiency = 69.4% and 94.44±78.01 errors). Other studies were similar to these results4,27. Based on the results of this review, it is concluded that the libero is a fundamental athlete for the reception of current volleyball where the jump serve is increasingly powerful. As the libero usually replaces the central player (an athlete who generally has a weak reception) at the time of the game before the serve, he becomes an essential athlete in this fundamental since most of the original studies and this review detected a superior reception by the libero when compared to the wing player.

The introduction of libero in amateur volleyball games can improve the team's technical performance. The professional defensive ability of the libero can make up for the deficiencies of other players' defense and reduce the team's errors, meanwhile, the higher quality of the libero's first pass can provide a better guarantee for the team's offense and make the team's offense more fluent. Previous studied, The effects of augmented jump training (PJT) on fitness indices of amateur and professional volleyball players (Ramirez-Campillo et al., 2021), that experiment in A total of 746 athletes were involved. The main findings indicated that PJT had small to moderate (p-value < 0.05) effects on linear sprint speed (ES = 0.70), deep squat jump (ES = 0.56), countermovement jump (ES = 0.80), arm-swing (ES = 0.63), deep jump (ES = 0.81), and snap jump height (ES = 0.84). The sub-analysis of moderators included 48 data sets. Only age had a significant effect on performance. Participants aged $\geqslant$ 16 years achieved greater

improvements in performance compared to those aged <16 years (ES = 1.28 and 0.38, respectively; p-value = 0.022). No significant differences were found among amateur enthusiasts (ES = 0.62) and professional volleyball players (ES = 1.01) (p-value = 0.422). In conclusion, from studies conducted on both males and females, PJT seems to be safe and effective in improving the physical fitness of both amateur and professional volleyball players. Form previous studied on the assessment of (VO_2max) index in amateur volleyball players (de Lima & Cardoso, 2012), the level of maximal oxygen uptake was assessed in amateur volleyball players from the state of Gibarana. Romania, by means of a 12-minute run and a 50-meter run test. The study was conducted on 16 amateur volleyball players aged 20 to 30 years old and all participants were male. For the purpose of the study, a 12-minute running test called the Cooper test was performed, in which the subjects ran for 12 minutes at a speed of 50 meters. It was concluded that volleyball players had lower than average maximal oxygen uptake indexes compared to physically fit professional athletes, suggesting that this study evaluated the effectiveness of regular exercise in this variable physiological and de-training aspect.

The addition of liberos enables amateur teams to better execute various tactics. Liberos can adjust their defensive positions in time according to the game situation and form an effective blocking system with other players. In offensive tactics, the participation of liberos can make the team's offense more diversified and increase the difficulty of the opponent's defense. Study References (Altavilla et al., 2022) This study conducted tests on two groups of elite and amateur volleyball players to verify whether there were significant differences among various physical indicators and jumping ability variables. Prior to the test, both groups of athletes received the same training program, which was conducted four times a week for a total of four months. Twenty-four volleyball players were divided into two groups. All the subjects were evaluated for the following physical measurements and jumping ability parameters: height, weight, body mass index, single-arm extension height, and double-arm extension height. results: In conclusion, somatometry and jumping ability profiles were directly related to the assessment in high-level youth volleyball; training and continuous monitoring of physical fitness and jumping

ability has become an important aspect in controlling athletic performance and selecting the best players.

The above synthesis shows that. It is expected that the absence of a libero will result in higher heart rate, increased RPE, decreased Lower muscle power test height, and higher NASA-TLX scores, indicating both greater physical exertion and cognitive load. The presence of a libero may reduce the physical load on non-defensive players, improving performance and lowering subjective workload. However, some case studies of amateur volleyball players, the effect of libero on the physical performance of their teammates during simulated matches, need to be further investigated. The Research on the impact of having with a libero and without libero on amateur volleyball games can be studied in the following research summary table 3.

TABLE 3 The studies investigating the Research on the impact of having with a libero and without libero on amateur volleyball games.

Citation	Title	Purpose	Conclusion
Bozhkova et al. (2013)	Playing efficiency of the best volleyball players in the world.	The best volleyball players from four top teams – Russia, Brazil, Poland and Argentina – were investigated for their game efficiency.	Has the defensive ability of with a libero Does not have the defensive ability of without a libero
Ramirez-Campillo et al. (2021)	Effects of plyometric jump training on physical fitness in amateur and professional volleyball: a meta-analysis.	Effects of plyometric jump training (PJT) on physical fitness parameters in amateur and professional volleyball players.	CMJ helps improve the physical fitness of both amateur and professional volleyball players.
Junior et al. (2014)	Does the high-level volleyball libero improve reception?	The review was to determine the efficiency of the libero in reception of the volleyball of high level.	The with a libero has a better success rate in catching the ball than a wing player. The with a libero has a lower turnover rate than a wing player.

TABLE 3 (continued).

Citation	Title	Purpose	Conclusion
De Lima et al. (2012)	Avaliação dos índices de vo2 máximo em atletas de voleibol amateur	The present study aimed to evaluate the maximum oxygen volume indices of amateur volleyball athletes through the 12-minute test and the 50-meter test.	Compared to healthy professional athletes, volleyball players have lower-than-average maximal oxygen consumption.
Altavilla et al. (2022)	Profile and Differences in Anthropometric Data and Jumping Ability Performance between Elite and Amateur U16 Volleyball Players.	Two groups of elite and amateur volleyball players were tested to determine if significant differences existed between different anthropometric and jumping ability variables.	Physical and jumping ability tests in high-level, youth volleyball competitions. improve performance in competitions.

CHAPTER 3

Research methodology

Determination of populations and participants

Populations

Amateur volleyball players in Yunnan Province, 24 amateur volleyball players (non-sports majors) were recruited from 12 higher vocational universities under the jurisdiction of Kunming, Yunnan Province, for the study.

Participants

In this study, 12 players were randomly selected from the whole team based on International Volleyball Federation (FIVB) (Official Volleyball Rules 2021, International Volleyball Federation (FIVB)), and previous studies in the field, with an effect size of 0.75 (García-de-Alcaraz & Usero, 2019), and a statistical power of 0.80. They were taking part in training, and the sample was randomly divided into two groups, group A 1,3,5,7,9,11; Group B 2,4,6,8,10,12.

Inclusion criteria

1. Age: 18-25 years old, male athlete.

2. At least 2 years of amateur volleyball competition with 6 months of intensive training required.

3. In good health, without cardiovascular or nervous system diseases.

4. Athletes are guaranteed to participate in more than 3 training sessions per week for at least 6 weeks.

5. Participated in provincial or above competitions, and the accumulated time on the field of play is not less than fifty percent.

6. The athlete must agree and sign a consent form.

Exclusion criteria

1. Musculoskeletal system injuries (such as unhealed knee or ankle surgery) or acute injuries (such as sprains or strains) within 2 weeks before the test.

2. Professional volleyball training history in the past 6 months (such as training time of more than 4 weeks), which affects the validity of data testing.

3. Long-term lack of participation in amateur volleyball competitions (if the number of games per week in the past 3 months is <2 times), unable to reflect the level of typical amateur athletes.

4. Failed to participate in the entire experimental process (Number of leave requests > 30% of total practice) or did not comply with training requirements and was excluded.

Research tools:

Quality tools

1.Heart rate testing equipment

POLAR (POLAR) sports heart rate chest strap, Model: POLAR-H10 (Rogers et al., 2022). the Polar H10 had relative errors ranging from 2.620% to 4.288%. (Lam et al., 2022). (Data transmission: support ANT +, standard Bluetooth, GymLink, Polar Beat APP) heart rate measurement range: 30-240bpm, Origin: Northern Europe Finland. (Schaffarczyk et al., 2022). High association and good to excellent agreement (r = 0.76-0.99, ICC2, k = 0.86-0.99) between ECG and Polar H-10 throughout all stages. (Ruiz-Alias et al., 2022).

2. Lower muscle power test

The test was conducted using the Countermovement Jump (CMJ) method. Test brand: High jump trainer jump test. Model: CSSIT (Pueo et al., 2020). (Test yourself with the High Jump Trainer and record your score for each test.) Origin: China. The Lower muscle power test had the highest relationship with the lower limb explosive strength factor (r = 0.87) (Markovic et al., 2004).

3. Rate of Perceived Exertion (RPE) (CR10).

The rate of perceived exertion (RPE) CR10 (r=0.83) (Scott et al., 2013).

4. NASA-TLX scale

The NASA Task Load Index. all NASA-TLX coefficients are greater than 0.80. (Xiao et al., 2005) and previous studied (Coelho et al., 2014; T. Mullen et al., 2021).

5. VO2max test

The Yo-Yo Intermittent Recovery Test Level 1 (YYIR1), High-intensity running covered by the players during games was correlated to Yo-Yo test performance ($r = 0.71$, P-VALUE < 0.05). (Krustrup et al., 2003).

Creation of research tools

Literature review: an in-depth literature review of the performance analysis of amateur volleyball players in simulated matches with and without libero was conducted with the aim of designing a training program for this study.

Development of the research protocol: performance analysis of simulated amateur volleyball matches (with and without libero) was studied and validated by experts in the field of sports science and literature review. The protocol was adapted to ensure that it meets the athletes' sport demands and scientific rigor.

Pilot testing: Pilot testing was conducted with a small number of athletes (N=12) to improve the measurement process and ensure the accuracy and feasibility of the test equipment.

Methods of data collection

Overview of the research process

This study used a randomized crossover experimental design. The sample group consisted of 12 amateur volleyball players who were trained to participate in a national college amateur volleyball tournament. Each data collection session had at least 3 assistants who were familiar with the data collection standards and methods. All tests were conducted from 6:00 a.m. to 7:30 a.m. During each test, the athletes were in the laboratory at a temperature of approximately 18-25 degrees Celsius. Prior to each test, subjects were asked to refrain from exercise or physical activity for at least 24 hours prior to the test and to avoid the following behaviors No food or energy drinks were consumed within 3 hours prior to the test. Basic data weight, height, resting heart rate, and Lower muscle power and VO_2max were tested. The tests were followed by 48 hours of rest and a simulated competition, respectively.

The simulated matches are shown below:

Match 1

Simulating Team A with a libero against Team B without a libero.

Match 2

Simulates Team A without a libero against Team B with a libero.

Match 3

Simulates Team A with a libero against Team B with a libero.

Match 4

Simulate Team A without a libero against Team B without a libero.

All matches are based on FIVB standards, using a research-based design of the libero conditions Please refer to the competition regulations. Each participant will conduct two simulations on different days. it is recommended to take at least a 48-hour break between simulations in order to minimize fatigue and enhance learning outcomes. Overall research procedure sees in figure 2.

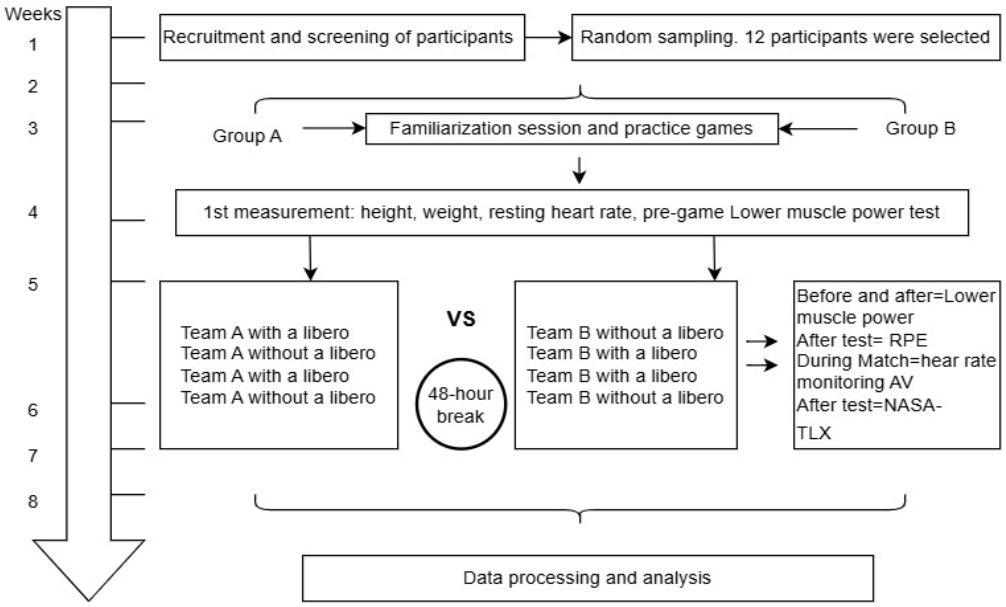


FIGURE 2 Overall research design and procedures

General data collection procedures

Basic data were collected for the sample group: participants arrived at the laboratory between 6:00 a.m. and 7:30 a.m. and were allowed to rest for 5-10 minutes and excluded to minimize the effects of environmental variables (e.g., temperature and humidity). Participants' resting heart rate (POLAR-H10 sports heart rate chest strap) was measured, followed by height, weight measurements and VO_2max. Prior to testing, participants were required to fast for at least three hours and avoid strenuous exercise for 24 hours prior to testing to ensure consistent metabolic conditions during testing.

VO_2max Test

The Yo-Yo intermittent recovery test level 1:

Required equipment: flat ground, cone-shaped barrel, a tape measure, a CD or MP3 player with high-quality speakers, audio files or CDs, and recording paper. (Hutajulu, 2016). Check for more detailed information about the required Yo-Yo testing equipment. (Figure 3)

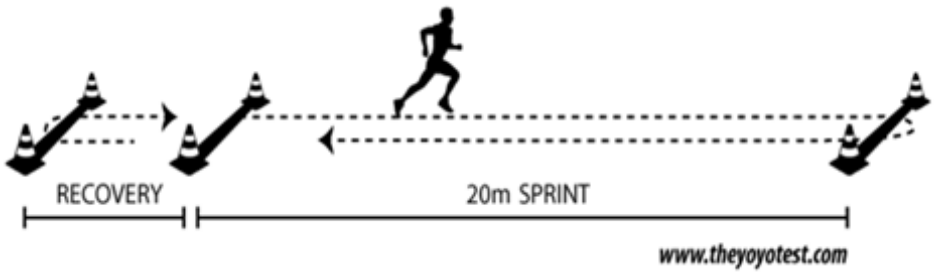


FIGURE 3 Yo-Yo Intermittent recovery test level 1 (Yo-Yo IR1)

Sources: (Hutajulu et al., 2016).

Course layout: As shown in the figure, use a cone or tape to mark three parallel lines, with distances of 5 meters and 20 meters between them (Supriatna et al., 2023).

Preparation test: Ensure that participants are well-prepared, have had sufficient rest, consumed adequate fluids and energy, are familiar with the test procedures, and

have the motivation to perform to their maximum potential. (For more detailed information, please refer to the preparation instructions for the Sliding Ball Test.)

Start of test: All participants should stand in row 1 along the starting line. The athletes start running from one foot behind the middle line (cone B) and follow the instructions of the audio recording. When the audio beep signal (at cone C) is emitted, the athlete turns and runs back to the starting point. The athlete must not start running prematurely; they must complete the entire course and arrive at each line before or on time for the record.

During the test: there is a 10-second active recovery period every 40 meters. During this period, the subjects must walk or jog to the next line (cone A) and return to the starting point. At regular intervals, the running speed will increase. The initial speed is 10.0 km/hr, then it increases to 12 km/hr, 13 km/hr, and then by 0.5 km/hr.

Experimental procedure

Warm-up preparation

Participants jogged 2 laps on the volleyball court floor, then performed stretching exercises in situ for 5 minutes, and immediately tested the athletes on Lower muscle power test (pre-competition), which is the optimal time to test Lower muscle power. Perform VO_2max test. (Yo-Yo Intermittent Recovery Test Level 1) (YYIR1). Then marching movement exercises (upper body, lower body, to whole body) were performed for about 3 minutes and one person padded the ball and two people practiced passing and catching the ball over short distances of no more than 3 meters. They also attempted two rounds of 3-meter movement exercises based on patterns and tests, followed by a 3-minute break to prepare for the tests. Warm-up and in situ stretching exercises were performed prior to performing the Lower muscle power test, test with the preparation pattern enabled.

Testing

All matches are based on the International Volleyball Federation (FIVB). standards using research-based design of the libero conditions. The specifics are based on the competition regulations. Competitions were conducted according to international

rules, and an amateur volleyball team with 12 players was experimented with the following conditions: After warming up, do a lower muscle power test immediately. 24 hours before the competition, test VO_2max. and then, they had to wear the POLAR Exercise Heart Rate Chest Strap Tester (POLAR-H10) test device, which was required to be worn throughout the match until the end of the match, and the simulation of the end of the match was performed by performing the Lower muscle power test, immediately evaluated using the SRPE (0-10), and then, at the end, evaluated using the NASA-TLX (Task Load Index). The simulated competition uses international rules. Each match will last approximately 4-5 sets.

Collecting data

Heart rate (HR) was measured continuously during the race using a heart rate monitor, and participants were required to wear a POLAR sports heart rate chest strap tester (POLAR-H10) throughout the race to record, average heart rate. Lower muscle power testing, using counter movement jump (CMJ) for pre- and post-match testing, is an assessment of lower muscle power. Rate of Perceived Exertion (RPE), assessed immediately after each set using SRPE (0-10) NASA-TLX (Task Load Index), measured post-competition to assess subjective cognitive load.

Measurement of variables

Heart rate

Heart rate (HR), measured continuously during the race with a heart rate monitor. The subjects' HR responses were monitored before, during and after the race by means of the HR Bluetooth monitoring system POLAR (POLAR, POLAR-H10, ANT+, standard Bluetooth, GymLink, Polar Beat APP, Nordic Finland). HR in beats per minute (bpm) was recorded every 5 seconds throughout the study to obtain the mean and peak HR of the subjects, and resting heart rate was measured in the supine position prior to the warm-up. All athletes were required to wear a POLAR (POLAR, POLAR-H10, ANT+, standard Bluetooth, GymLink, Polar Beat APP, Nordic Finland) heart rate monitor throughout the simulated competition.

Lower muscle power test

For the Lower muscle power test, pre- and post-competition testing was performed using a countermovement jumps (CMJ), which measures the explosive power of the leg muscles, tests the ability to jump vertically and can assess the explosive power of the lower limbs to assess lower body strength (Sattler et al., 2012) each subject performed 3 jumps with 1 minute rest between each jump to achieve optimal jumping performance. The optimal jumping performance was statistically analyzed and tested with reference to a previous study (Ramírez-Campillo et al., 2013). (Figure 4)

FIGURE 4 The countermovement jumps (CMJ)

Test method: The subject stands on the ground and jumps vertically as hard as possible, and the jumping height is measured (it can be measured by a contact height gauge or infrared equipment).

The tester stands with his feet naturally parallel and shoulder-width apart, his arms hanging naturally or placed at both sides of the body, and his body keeping upright.

The second phase is the tester bends the legs in a semi-squat so that the hip and knee joints are jointly bent, the arms are swung back as far as possible, and the center of gravity is lowered.

The third phase is the after receiving the command, the tester swings the arms forward and upward rapidly, and the legs are simultaneously exerted to extend the legs, knee joints and ankles, and tries his/her best to jump vertically upward until the highest point.

The fourth phase is the after the body reaches the highest point, the center of gravity of the body drops, and both feet land smoothly to maintain balance.

Rate of perceived exertion

Rate of Perceived Exertion (RPE), assessed using RPE (0-10) immediately after each set (Zamunér et al., 2011). The RPE used tool in sports and exercise settings to measure the intensity of an activity. (Table 4)

TABLE 4 Rating of perceived exertion scale (RPE)

Rating	Descriptor
0	Rest
1	Very. very easy
2	Easy
3	Moderate
4	Somewhat hard
5	Hard
6	
7	Very hard
8	
9	
10	Maximal

Mental workload

The NASA Task Load Index (NASA-TLX), measured after the race to assess subjective mental workload (Note: test immediately after the game...) (Thomas Mullen et al., 2021; Xiao et al., 2005). Using NASA-TLX, athletes can assess their perceived workload in areas such as Mental demand (e.g., focus during a game), Effort (e.g., mental resilience during intense matches) and Performance (e.g., self-assessed effectiveness).

NASA-TLX scale dimension scoring: Subjects scored 6 dimensions (mental needs, physical burden, time requirement, mission performance, effort, frustration) on the scale. All questions, except the performance question, offered a scale ranging from "very low" to "very high". The rating scale for the performance question ranged from "perfect" to

"failure". Each question's scale ranged from 1 to 11. Based on the scores, the total score was calculated: the original score of each dimension was multiplied by the corresponding weight, and then the sum was divided by 6 to get the final load score. The higher the score, the greater the task load (Braarud, 2021). See in Appendix E.

Data processing and analysis

The quantitative data were analyzed in this study using the SPSS computer program. (SPSS version 24, IBM Corporation, Illinois, USA).

Statistics used in the research

To find the mean ((X)) and standard deviation (S.D.) of height, weight and body fat index, AvrHR, Lower muscle power test, Rate of perceived exertion (RPE), and NASA-TLX (Task Load Index). The independent sample T-Test was used for analyzed data from AvrHR, RPE and NASA-TLX The Lower muscle power test, was analyzed pre and post matched by Paired sample T-Test. This study used Shapiro-Wilk Test for statistic to check the normality of data distribution to ensure it met the assumptions for parametric tests. A significance was set at level of $p\text{-value} < 0.05$.

CHAPTER 4

Results

Data analysis results presentation

This presentation is mainly divided into two topics: basic information of the sample group and sports performance response.

Physical characteristics of participants

The sample group of this study has general physical characteristics.

TABLE 5 General physical characteristics information

Physical Characteristics	Mean ± SD
Age (years)	19.17±1.11
Height (cm)	175.79±4.40
Weight (kg)	70.44±4.32
BMI (kg/m²)	22.85±0.37
VO_2max (ml/min/kg)	46.84±2.38

Heart rate data

The average heart rate (AvrHR) and percentage heart rate (PHR)

The results showed that the heart rate was significantly higher in the without a libero than in the with a libero. (162.18±5.79 vs 149.79±9.18, P-VALUE < 0.05) (Figure5). Similarly, the PHR also showed that the PHR was significantly higher in the without a libero than in the with a libero. (80.85±2.92 vs.75.34±5.20, P-VALUE < 0.05) (Figure6). All data are shown in Table 6.

TABLE 6 Compare the differences of HR and PHR (With Libero and Without Libero)

Variables	Group	Mean	*P*
AvrHR (bpm)	With Libero	149.79±9.18	0.023*
	Without Libero	162.18±5.79 #	
PHR (%)	With Libero	75.34±5.20	0.030*
	Without Libero	80.85±2.92 #	

* The differences between conditions were statistically significant p-value < 0.05

The mean is statistically significantly higher p-value < 0.05

AvrHR and PHR:

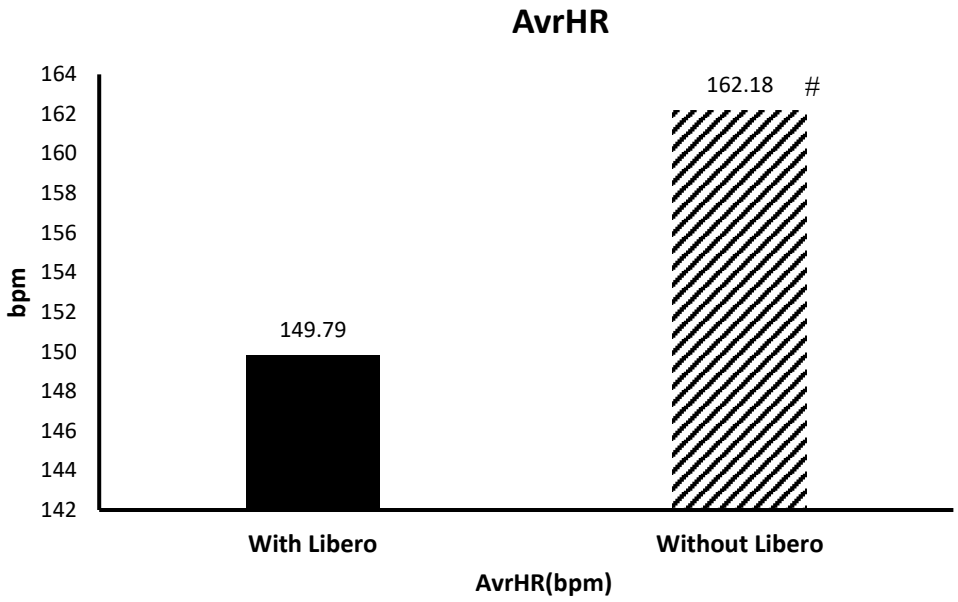


FIGURE 5. Compare the differences of AvrHR

The mean is statistically significantly higher p-value < 0.05

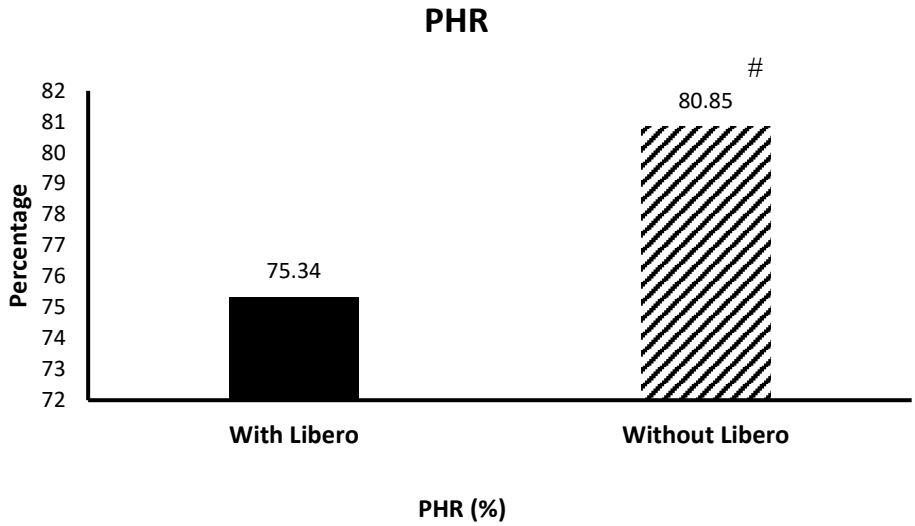


FIGURE 6. Compare the differences of PHR (%)

[#] The mean is statistically significantly higher p-value < 0.05

Compare the results of Rate of perceived exertion (sRPE) and The NASA Task Load Index (NASA-TLX)

The results showed that the Rate of perceived exertion (sRPE) was significantly higher in the without a libero than in the with a libero. (7.90±0.72 vs. 6.50±0.88, P-VALUE < 0.05) (Figure 7). Similarly, The NASA-TLX score was also significantly higher in the without a libero than in the with a libero. (52.95±3.86 vs. 42.75±4.04, P-VALUE < 0.05) (Figure 8). All data are shown in Table 7.

TABLE 7 Compare the differences of sRPE and NASA-TLX (With Libero and Without Libero)

Variables	Group	Mean	*P*
sRPE	With Libero	6.50±0.88	0.001*
	Without Libero	7.90±0.72 #	
NASA-TLX	With Libero	42.75±4.04	0.001*
	Without Libero	52.95±3.86 #	

* The differences between conditions were statistically significant p-value < 0.05.

The mean is statistically significantly higher p-value < 0.05

RPE: Rate of perceive exhaustion, NASA-TLX: NASA Task Load Index

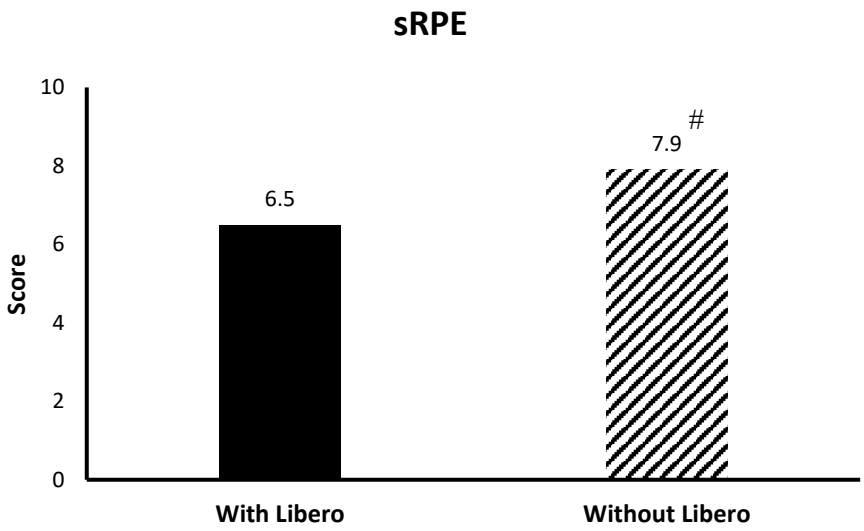


FIGURE 7. Compare the differences of sRPE

The mean is statistically significantly higher p-value < 0.05

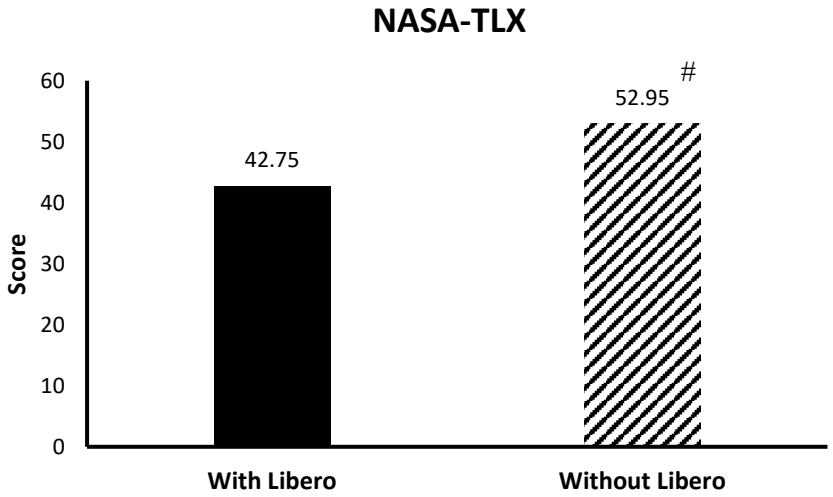


FIGURE 8. Compare the differences of NASA-TLX

[#] The mean is statistically significantly higher p-value < 0.05

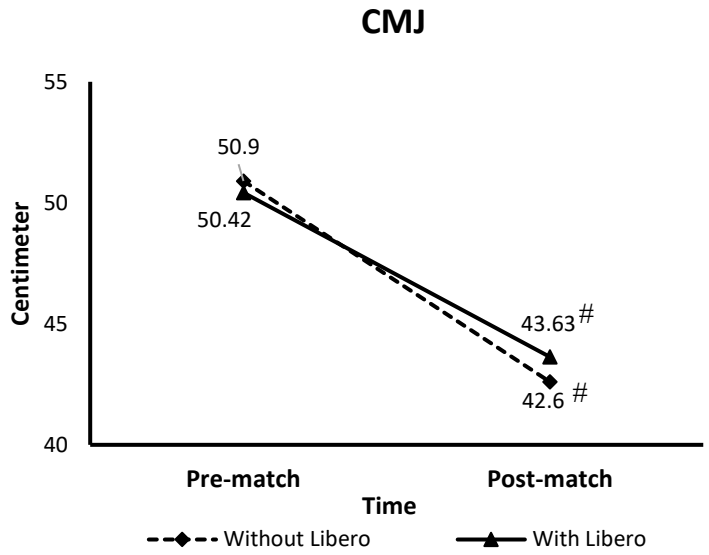
Comparative results of Countermovement jump (CMJ)

The results of lower muscle power test performance showed that the differences within the groups were statistically significant in both the With Libero and Without Libero conditions (p-value < 0.05). In the With Libero condition, the mean scores before and after the experiment were 50.42 ± 2.45 and 43.63 ± 3.92, respectively; while in the Without Libero condition, the mean scores before and after the experiment were 50.90 ± 2.33 and 42.60 ± 4.38, respectively (Figure9). However, when analyzing the condition × period of the Lower muscle power test, no interaction was found (p-value = 0.145). All result show in table 8.

TABLE 8 The mix model ANOVA analyze the interaction of lower muscle power test in each condition

Condition/ Period	Pre-match	Post-match	Between	Interaction
With Libero	50.42±2.45	43.63±3.92	0.757	0.145
Without Libero	50.90±2.33	42.60±4.38		
Within Group	0.001*			

* The main effect differences were statistically significant p-value < 0.05



Significantly different within groups P-VALUE <0.05

FIGURE 9. Differences in lower muscle power test post-test between with libero vs without libero

CHAPTER 5

Discussion and conclusion

The Libero Defensive Player is a special role in volleyball. Libero usually have excellent defensive skills and quick reaction ability. their presence can greatly improve the team's defensive ability and reduce the opponent's scoring opportunities. The importance of liberos in the game is that they can provide more offensive opportunities for their teammates and relieve the pressure of other players on defense. The libero plays an important role in amateur volleyball. In simulated games, teams with a libero demonstrate superior defensive performance, including more successful digs and quicker transitions from defense to offense, as compared to teams without a libero. For amateur volleyball players, their performance may be different in simulated matches with and without a free man. The libero is a key defensive player whose job is to receive serves and defend against opponents' attacks. The presence or absence of a libero in a team can affect the player's movement characteristics and mental load during a match. This study aimed to compare the effects of the with or without of a libero in an amateur volleyball team. This study will outline the conclusions and discussions of this study in the following order: Brief Summary of the Study, discussion of results, conclusions and suggestions for further research, and practical application of research results

Brief summary of the study

This study evaluated the performance and physiological responses of amateur volleyball players during simulated matches with and without the libero. The researchers collected data and summarized the results as follows

AvrHR and PHR

The results showed that the heart rate was significantly higher in the without a libero than in the with a libero. Similarly, the PHR also showed that the PHR was significantly higher in the without a libero than in the with a libero.

sRPE and NASA-TLX

The results showed that the self-reported perceived fatigue (sRPE) was significantly higher in the without a libero than in the with a libero. Similarly, The NASA-TLX score was also significantly higher in the without a libero than in the with a libero.

Lower muscle power test performance

The results of countermovement jump showed that the differences within the groups were statistically significant in both the With Libero and Without Libero conditions. respectively. However, when analyzing the condition × period of the Lower muscle power test, no interaction was found.

Discussion of research results

This study investigated the performance and physiological responses of amateur volleyball players during simulated matches with or without the libero. The results of this study found that after simulating four competition conditions, Team A with a libero vs. Team B without a libero, Team A without a libero vs. Team B with a libero, both teams with a libero, and both teams without a libero. The results indicated that HR and PHR of the libero team were both lower than the non-libero team, as well as sRPE of the libero team being lower than the non-libero team, and NASA-TLX for the libero team being lower than the non-libero team. In addition, the two Lower muscle power teams had a decrease in jump height after the competition, but no significant difference was found between the teams with and without liberos. Liberal players helped the team to effectively manage physical and mental workload and reduce competition stress but were not related to jumping performance in the competition.

AvrHR and PHR

The results of the study found that the average heart rate (HR) and percentage heart rate (PHR) of the team with the libero were significantly lower than those of the team without the libero. This can be explained by the specific role and responsibilities of the libero position, which focuses on defense and does not involve high-energy movements such as jumping to block or spike. Since the rules of volleyball do not allow the libero to attack or play in front of the net (González et al., 2005), the total energy

expenditure throughout the match of the libero is significantly lower than that of other players. When the team has a specialized libero to play defense instead of a non-expert defender, the physical load on the other players overall is reduced, resulting in a lower average heart rate for the team (AkarçeŞme et al., 2022).

Volleyball games usually consist of short bursts of high-intensity activity followed by low-intensity activity. The total duration of a game is approximately 60-90 minutes (AkarçeŞme et al., 2022). There are differences in the heart rate levels of athletes in different positions before, during, and after a volleyball game. The player who completed the game with the highest intensity was the libero. (Gielen et al., 2020) Low-intensity (very light to light intensity <57% to <64%) activities were observed in more than half of the games. In volleyball training, 50%-60% of the training time can maintain the load intensity at or below 60% of the maximum heart rate (HRmax), and 10% (average) of the training time can reach 80% or more of the maximum heart rate (HRmax). In addition to arranging training with specific load intensities according to the athlete's position, it is also very important to perform high-intensity activities with long rest intervals. (AkarçeŞme et al., 2022).

sRPE and NASA-TLX

Rating of perceived exertion (RPE) is a non-invasive, cost-effective, and time-saving method for measuring training load. Data collection does not follow a specific procedure and is varied. Therefore, professional volleyball practitioners can use this information in a variety of ways, with varying assessment criteria. Therefore, this review aims to systematically and critically evaluate the use of RPE-based methods in professional volleyball players (Rebelo et al., 2023). We conducted an electronic search in four databases (PubMed, SPORTDiscus, Scopus, and Web of Science). Ten articles were retrieved and included in the systematic review. All included studies calculated the RPE of a training session using the BORG-CR10 scale. The main findings suggest that in order to minimize the impact of the last exercise in a training session, athletes should ask and answer the RPE question within 10 to 30 minutes after the end of the training session.

The Rate of Perceived Exertion (sRPE) of players on teams with Liberos was found to be lower, reflecting reduced mental and physical fatigue. The presence of liberos reduces the frequency and intensity of vertical movement and defensive load, resulting in less need for other players, especially outside hitters and setters, to adjust their positions to help receive the ball as much as teams without liberos (García-de-Alcaraz & Usero, 2019; Rebelo et al., 2023). The reduction in physical workload redundancy leads to lower fatigue perceptions, especially in the sRPE system using the Borg CR-10 scale, which reflects a combination of physical and mental fatigue (Foster et al., 2001).

In the aspect of stress assessment or mental workload, measured using the NASA-TLX questionnaire, the results showed that players in teams with Liberos had lower average scores than teams without Liberos. This can be explained by the fact that the libero position is primarily responsible for initiating defensive plays, especially in receiving serves and offensive balls, which are continuously trained in a specialized manner so that players in other positions do not have to make urgent decisions in stressful situations as often as teams without liberos, resulting in reduced mental workload (Coelho et al., 2014; Marra et al., 2019; Mesquita et al., 2007). In addition, having players with high self-confidence in this position also helps create psychological stability for the overall team (Machado et al., 2024).

Lower muscle power performance

The results of counter movement jump test measurement found that the jump height of players in both teams with and without a libero decreased significantly after the match, but there was no difference between the groups. This is explained by the neuromuscular load caused by the competition, which has a similar effect on all positions, whether with or without a libero (Kipp et al., 2021; Rebelo et al., 2024). This decrease is a result of accumulated fatigue that the team cannot immediately compensate for after the competition. Although the libero has a low competition workload and results in a lower workload for the team in other areas, the impact on the overall team in terms of Lower muscle power test is not different, because the positions that have to jump frequently, such as middle blocker and opposite, still inevitably bear the same load (García-de-

Alcaraz et al., 2020). This is consistent with the fact that jump performance has no relationship with RPE (Pawlik & Mroczek, 2022).

Lower muscle power test results showed that after the game, the jump height of both teams with and without libero decreased significantly, but there was no difference between the two groups. The unique body shape and proportions of volleyball players may be an important prerequisite for successful participation in volleyball. All athletes perform stretch-shortening cycle movement patterns in different positions of volleyball (e.g., digging). (Marques et al., 2009). Elite volleyball players in different positions do not differ in lower limb muscle strength. Considering that in volleyball, teams compete through high overhead spiking and blocking skills. Since volleyball requires overhead ball control, height can be considered the most important physical attribute (Stanganelli et al., 2008). The fact that the average height of volleyball players is among the highest in international teams also supports this view. Some authors believe that height is an important predictor of volleyball talent and the presence of tall players is an indispensable factor for team success.

Summary of the discussion

Overall, the analysis suggests that the role of the libero has a systemic effect on reducing both the physical and mental workload of the team, especially in terms of HR, PHR, RPE, and mental workload, which are consistently reduced. However, in neuromuscular fatigue indicators such as Lower muscle power, the limitations of having a libero in reducing physical fatigue at the team level may need to be considered in addition to the substitution strategies, rest, and more specialized training plans. Other factors should also be considered, such as the experience of the libero, which in world-class teams tends to have players with an older average age, reflecting expertise that positively affects the team's mental workload (Merghes & Gradinaru, 2014). When combined with precise positioning and strategic assessment in each phase or situation of the game (García-de-Alcaraz & Usero, 2019). teams with a libero are more effective in controlling the game's tempo and reducing pressure from various situations. In addition,

in different situations, there should be training to prepare mentally to be ready for the competition as well (Boichuk et al., 2020).

CONCLUSION

Although this study focused on amateur volleyball players, the nature of the competition may be similar but may differ in terms of player performance and high-level playing tactics. The evidence clearly shows that the libero position not only affects the team's energy allocation but also plays a psychological role in enhancing defensive stability, reducing mental workload, and helping the team to manage fatigue more effectively at the match level. Coaches should consider the results of this study together with their competition strategies to apply them in competitions.

Application of the Findings

1. Team configuration optimization: Amateur volleyball players should give priority to setting up the role of libero, and choose liberos with flexible mobility and solid defensive skills to defend, improve the team's defensive efficiency and reduce the overall load.

2. Game strategy adjustment: Coaches can use heart rate monitoring to evaluate the player's load in real time, set rotation strategies for the core players (such as main attackers) of the team without liberos, and avoid excessive fatigue. Take advantage of the psychological stability of the libero, emphasize his defensive responsibility in key games, and improve the team's ability to withstand pressure.

3. Physical performance: The physical performance of athletes has a significant impact on the athlete's own skills and the team's tactics. Therefore, volleyball players must have the physical performance that meets the requirements of this sport.

Recommendations

1. Explore the differences in the impact of liberos on young people and high-level teams, and further verify the conclusion that liberos have an impact on amateur volleyball players.

2. Conduct a season cycle study to observe the impact of libero configuration on chronic fatigue accumulation and sports injury risks, and improve the theory of training load management.

3. Physical performance is crucial to the sport of volleyball. By measuring some basic physical parameters of volleyball players, such as flexibility, muscle endurance, strength and cardiorespiratory endurance, and finding out the deficiencies in physical performance levels, some valuable suggestions can be made to improve the athletic level of volleyball players.

REFERENCES

AkarçeŞme, C., Cengizel, E., Şenel, Ö., Yıldıran, İ., Akyildiz, Z., & Nobari, H. (2022). Heart rate and blood lactate responses during the volleyball match. *Scientific reports*, *12*(1), 15344.

Altavilla, G., Esposito, G., Ceruso, R., Di Domenico, F., & D'Isanto, T. (2022). Profile and Differences in Anthropometric Data and Jumping Ability Performance between Elite and Amateur U16 Volleyball Players. *Physical Education Theory and Methodology*, *22*(2), 237-241.

Aniszewski, E., Henrique, J., Silva, G. S., Mascimiano, G., Penna, T. A., & Oliveira, A. J. (2024). Motivational factors for adult amateur volleyball athletes. *Journal of Physical Education*, *35*, e3508.

Bangsbo, J., Iaia, F. M., & Krustrup, P. (2008). The Yo-Yo intermittent recovery test: a useful tool for evaluation of physical performance in intermittent sports. *Sports medicine*, *38*, 37-51.

Boichuk, R., Iermakov, S., Vintoniak, O., Hrabchuk, A., & Bieliavskyi, I. (2020). Influence of psychophysiological factors on the effectiveness of competitive activity of volleyball players (girls) aged 16 to 18. *J. Phys. Educ. Sport*, *20*, 2392-2399.

Bozhkova, A. (2013). Playing efficiency of the best volleyball players in the world. *Research in Kinesiology*, *41*(1), 92-95.

Braarud, P. Ø. (2021). Investigating the validity of subjective workload rating (NASA TLX) and subjective situation awareness rating (SART) for cognitively complex human–machine work. *International Journal of Industrial Ergonomics*, *86*, 103233.

Cartagena Durán, E. (2019). Influencia del líbero en el voleibol de alto rendimiento.

Coelho, D., Filipe, J., Simões-marques, M., & Nunes, I. (2014). The Expanded Cognitive Task Load Index (NASA-TLX) applied to Team Decision-Making in Emergency Preparedness Simulation. 2015; 225-236. *Human Factors and Ergonomics Society Europe*.

Darya, S. (2024). EXPERIMENTAL STUDY OF PSYCHOLOGICAL FEATURES OF WOMEN'S AND MEN'S AMATEUR VOLLEYBALL TEAMS. The 17th International scientific and practical conference “The latest technologies in the development of science, business and education”(April 30–May 03, 2024) London, Great Britain. International Science Group. 2024. 446 p.,

de Lima, A. P., & Cardoso, F. B. (2012). Avaliação dos índices de VO2 máximo em atletas de voleibol amador. *RBPFEX-Revista Brasileira de Prescrição e Fisiologia do Exercício*, *6*(31).

Forthomme, B., Croisier, J.-L., Ciccarone, G., Crielaard, J.-M., & Cloes, M. (2005). Factors correlated with volleyball spike velocity. *The American journal of sports medicine*, *33*(10), 1513-1519.

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

García-de-Alcaraz, A., Ramírez-Campillo, R., Rivera-Rodríguez, M., & Romero-Moraleda, B. (2020). Analysis of jump load during a volleyball season in terms of player role. *Journal of science and medicine in sport*, *23*(10), 973-978.

García-de-Alcaraz, P. A., & Usero, L. (2019). Influence of contextual variables on performance of the libero player in Top-Level women’s volleyball. *Journal of human kinetics*, *70*, 199.

Gielen, J., Mehuys, E., Eyckmans, K., & Aerts, J.-M. (2020). Heart Rate and Activity Measured during Volleyball Competition using Wearable Technology. icSPORTS,

González, C., Ureña Espa, A., Llop, F., Garcia, J., Martin, A., & Navarro, F. (2005). Physiological characteristics of libero and central volleyball players.

Hutajulu, P. (2016). Pengaruh Latihan High Intensity Interval Training Dalam Meningkatkan Nilai Volume Oksigen Maksimum Atlet Sepabola Junior (U-18). *Jurnal Penjakora*, *3*(1), 1-10.

Isabel, M., Manso, F., & Palao, J. (2007). Defensive participation and efficacy of the libero in volleyball. *Journal of Human Movement Studies*, *52*, 95-108.

Junior, N. K. M. (2014). O líbero do voleibol de alto nível melhora a recepção. *Revista Brasileira de Ciência e Movimento*, *22*(3), 133-138.

Kipp, K., Kiely, M., & Geiser, C. (2021). Competition volume and changes in countermovement jump biomechanics and motor signatures in female collegiate volleyball players. *The Journal of Strength & Conditioning Research*, *35*(4), 970-975.

Krustrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., Pedersen, P. K., & Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine & science in sports & exercise*, *35*(4), 697-705.

Lam, E., DuPlessis, D., Hutchison, M., Scratch, S., & Biddiss, E. (2022). Validation of the polar H10 accelerometer in a sports-based environment. *Engineering Proceedings*, *27*(1), 71.

Lin, K. (2014). Applying Game Theory to Volleyball Strategy. *International Journal of Performance Analysis in Sport*, *14*(3), 761-774. https://doi.org/10.1080/24748668.2014.11868756

Machado, T. d. A., Balaguer, I., Prado-Gascó, V. J., Muiños, P., Lirani, L. d. S., & Stefanello, J. M. F. (2024). Are there differences in the self-efficacy of volleyball players in relation to their position? *Psicologia: teoria e prática*, *26*(2).

Markovic, G., Dizdar, D., Jukic, I., & Cardinale, M. (2004). Reliability and factorial validity of squat and countermovement jump tests. *The Journal of Strength & Conditioning Research*, *18*(3), 551-555.

Marques, M. C., Van den Tillaar, R., Gabbett, T. J., Reis, V. M., & González-Badillo, J. J. (2009). Physical fitness qualities of professional volleyball players: determination of positional differences. *The Journal of Strength & Conditioning Research*, *23*(4), 1106-1111.

Marra, F., Aquino, M., & Altavilla, G. (2019). Longitudinal case study of the role of libero in volleyball.

Merghes, P. E., & Gradinaru, S. (2014). Comparative Analysis of the" Libero" in great Performance Volleyball. *Timisoara Physical Education and Rehabilitation Journal*, *6*(12), 23.

Mesquita, I., Manso, F., & Palao, J. (2007). Defensive participation and efficacy of the libero in volleyball. *Journal of Human Movement Studies (JHMS)*, *52*(2), 95.

Mullen, T., Twist, C., Daniels, M., Dobbin, N., & Highton, J. (2021). Influence of Contextual Factors, Technical Performance, and Movement Demands on the Subjective Task Load Associated With Professional Rugby League Match-Play. *Int J Sports Physiol Perform*, *16*(6), 763-771. https://doi.org/10.1123/ijspp.2019-0998

Mullen, T., Twist, C., Daniels, M., Dobbin, N., & Highton, J. (2021). Influence of contextual factors, technical performance, and movement demands on the subjective task load associated with professional rugby league match-play. *International Journal of Sports Physiology and Performance*, *16*(6), 763-771.

Palao, J. M., Santos, J., & Ureña, A. (2004). Effect of team level on skill performance in volleyball. *International Journal of Performance Analysis in Sport*, *4*(2), 50-60.

Pawlik, D., & Mroczek, D. (2022). Fatigue and training load factors in volleyball. *International journal of environmental research and public health*, *19*(18), 11149.

Pisa, M. F., Zecchin, A. M., Gomes, L. G., Norberto, M. S., & Puggina, E. F. (2022). Internal load in male professional volleyball: a systematic review. *The Journal of Sports Medicine and Physical Fitness*, *62*(11), 1465-1473.

Pueo, B., Penichet-Tomas, A., & Jimenez-Olmedo, J. (2020). Reliability and validity of the Chronojump open-source jump mat system. *Biology of sport*, *37*(3), 255-259.

Ramírez-Campillo, R., Andrade, D. C., & Izquierdo, M. (2013). Effects of plyometric training volume and training surface on explosive strength. *J Strength Cond Res*, *27*(10), 2714-2722. https://doi.org/10.1519/JSC.0b013e318280c9e9

Ramirez-Campillo, R., García-de-Alcaraz, A., Chaabene, H., Moran, J., Negra, Y., & Granacher, U. (2021). Effects of plyometric jump training on physical fitness in amateur and professional volleyball: a meta-analysis. *Frontiers in Physiology*, *12*, 636140.

Rebelo, A., Pereira, J. R., Cunha, P., Coelho-e-Silva, M. J., & Valente-dos-Santos, J. (2024). Training stress, neuromuscular fatigue and well-being in volleyball: a systematic review. *BMC Sports Science, Medicine and Rehabilitation*, *16*(1), 17.

Rebelo, A., Pereira, J. R., Martinho, D. V., & Valente-dos-Santos, J. (2023). Rating of perceived exertion in professional volleyball: A systematic review. *Journal of human kinetics*, *87*, 143.

Rentero, L., Joao, P., & Moreno, M. (2015). ANALYSIS OF THE LÍBERO'S INFLUENCE IN DIFFERENT MATCH PHASES IN VOLLEYBALL. *International Journal of Medicine & Science of Physical Activity & Sport/Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte*, *15*(60).

Rogers, B., Schaffarczyk, M., & Gronwald, T. (2022). Estimation of respiratory frequency in women and men by Kubios HRV software using the polar H10 or Movesense Medical ECG sensor during an exercise ramp. *Sensors*, *22*(19), 7156.

Ruiz-Alias, S. A., Marcos-Blanco, A., Clavero-Jimeno, A., & García-Pinillos, F. (2022). Examining weekly heart rate variability changes: a comparison between monitoring methods. *Sports Engineering*, *25*(1), 7. https://doi.org/10.1007/s12283-022-00371-8

Sánchez, M., González-Silva, J., Fernández-Echeverría, C., Claver, F., & Moreno, M. P. (2019). Participation and influence of the libero in recepcion and defence, in volleyball U-19 [Article]. *Revista Internacional de Medicina y Ciencias de la Actividad Fisica y del Deporte*, *19*(73), 45-62. https://doi.org/10.15366/rimcafd2019.73.004

Sattler, T., Sekulic, D., Hadzic, V., Uljevic, O., & Dervisevic, E. (2012). Vertical jumping tests in volleyball: reliability, validity, and playing-position specifics. *The Journal of Strength & Conditioning Research*, *26*(6), 1532-1538.

Schaffarczyk, M., Rogers, B., Reer, R., & Gronwald, T. (2022). Validity of the Polar H10 Sensor for Heart Rate Variability Analysis during Resting State and Incremental Exercise in Recreational Men and Women. *Sensors (Basel)*, *22*(17). https://doi.org/10.3390/s22176536

Scott, T. J., Black, C. R., Quinn, J., & Coutts, A. J. (2013). Validity and reliability of the session-RPE method for quantifying training in Australian football: a comparison of the CR10 and CR100 scales. *The Journal of Strength & Conditioning Research*, *27*(1), 270-276.

Silva, H.-H., Tavares, V., Neto, B. V., Cerqueira, F., Medeiros, R., & Silva, M.-R. G. (2023). FAAH rs324420 polymorphism: biological pathways, impact on elite athletic performance and insights for sport medicine. *Genes*, *14*(10), 1946.

Singh, M. K., Lal, R., Patel, R. K., & Chaudhary, R. (2021). Prediction of Libero's Performance on the basis of Selected Anthropometric Characteristics. *Journal of Ravishankar University*, *27*(1), 89-98.

Soflu, H. G., & Esfahani, N. (2011). The relationship between conceptual imagery, team efficiency and performance in amateur and professional volleyball players. *Procedia-Social and Behavioral Sciences*, *30*, 2369-2373.

Sousa, A. C., Marques, D. L., Marinho, D. A., Neiva, H. P., & Marques, M. C. (2023). Assessing and monitoring physical performance using wearable technologies in volleyball players: a systematic review. *Applied Sciences*, *13*(7), 4102.

Stanganelli, L. C. R., Dourado, A. C., Oncken, P., Mançan, S., & da Costa, S. C. (2008). Adaptations on jump capacity in Brazilian volleyball players prior to the under-19 World Championship. *The Journal of Strength & Conditioning Research*, *22*(3), 741-749.

Supriatna, E., Suryadi, D., Haetami, M., & Yosika, G. F. (2023). Analysis Endurance Profile (Vo2max) of Women's Volleyball Athletes: Yo-yo intermittent test level 1. *Indonesian Journal of Physical Education and Sport Science*, *3*(1), 12-19.

Taware, G. B., Bhutkar, M. V., & Surdi, A. D. (2013). A profile of fitness parameters and performance of volleyball players. *Journal of Krishna Institute of Medical Sciences University*, *2*(2), 48-59.

Xiao, Y., Wang, Z., Wang, M., & Lan, Y. (2005). The appraisal of reliability and validity of subjective workload assessment technique and NASA-task load index. *Zhonghua lao dong wei sheng zhi ye bing za zhi= Zhonghua laodong weisheng zhiyebing*

zazhi= Chinese journal of industrial hygiene and occupational diseases, *23*(3), 178-181.

Zamunér, A. R., Moreno, M. A., Camargo, T. M., Graetz, J. P., Rebelo, A. C., Tamburús, N. Y., & da Silva, E. (2011). Assessment of subjective perceived exertion at the anaerobic threshold with the Borg CR-10 scale. *Journal of sports science & medicine*, *10*(1), 130.

Zetou, E., et al. (2007). The effect of the libero player on the defensive function of elite female volleyball teams. .

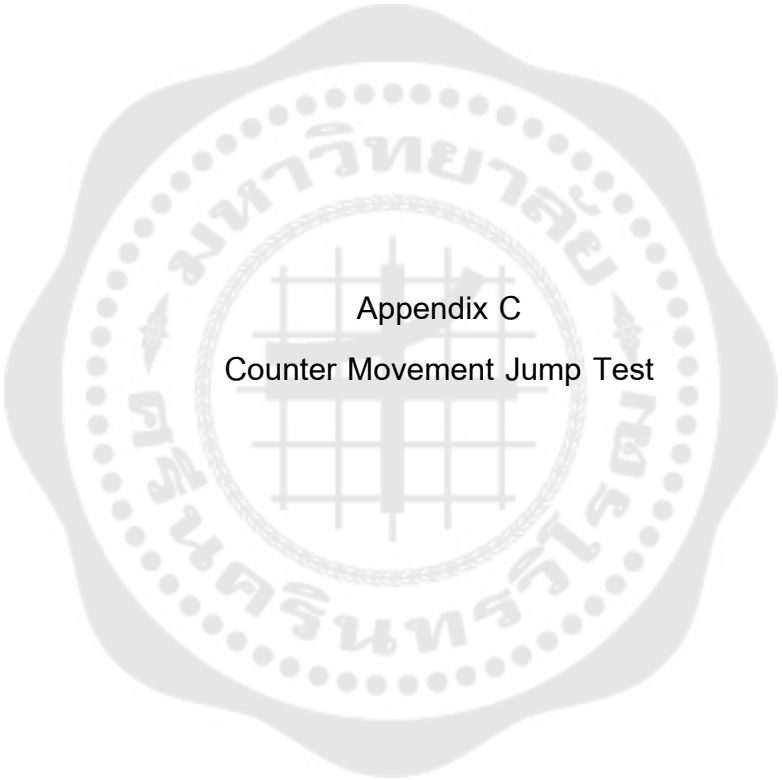
Appendix A

Yo-Yo Intermittent Recovery Test Level 1 (YYIR1)

Appendix B

Physical characteristics test

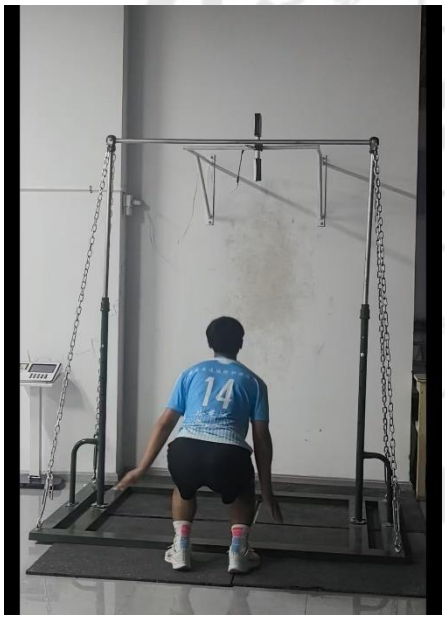

VOLLEYBA
12
13
6
11
12



Appendix C

Counter Movement Jump Test




Appendix D

Human Research Ethics Approval Document

Approval Form for Ethical Review of Research Experiments in Yunnan Vocational College of Transportation

Numbering: YJYY-2025SS-5310

Project name	The Influence of Libero Players on Teammate Physical Performance in Simulated Matches: A Case Study of Amateur Volleyball Athletes
Project Institution	Yunnan Vocational College of Transportation
Project Manager	YONG JUN PU
Type of review	☐ Apply for animal testing ☐ Declaration of scientific research topics ☐ Other than (√)

(The main research content and the ethical experimental program involved, including the purpose of animal experiments, experimental methods, observational indicators, and methods of disposing of animals after experiments, etc.)

Purpose of the study: The Influence of Libero Players on Teammate Physical Performance in Simulated Matches. To assess the performance and physiological responses of amateur volleyball athletes in a simulated game with and without the libero. The study will evaluate heart rate, countermovement jump (CMJ), VO2max, Rate of Perceived Exertion (RPE), and NASA-TLX (Task Load Index) to measure both physical and cognitive load.

Test Subject: Amateur volleyball players from higher vocational schools in Kunming, Yunnan Province.

Test Program: The subjects of this study are mainly 24 amateur volleyball players from Yunnan Province Transportation Vocational School, aged 18-25 years old, to participate in this study. They will be used as experimental subjects for Simulation of competition with libero and without libero. before the beginning of the experiment, the selected subjects are voluntary to participate, sign the consent form, understand the experimental process to ensure that they are fully informed and respect their wishes, ask and investigate the health status of the subjects, to determine the mental health of the subjects. All subjects did not undergo any type of lower limb surgery and did not have any problems such as diseases. In this study, 12 players were randomly selected from the whole team (FIVB Rules. (2021). *Official Volleyball Rules*. International Volleyball Federation.). They were taking part in training, and the sample was randomly divided into two groups, group A 1,3,5,7,9,11; Group B 2,4,6,8,10,12. The purpose of this step is to ensure the objectivity and randomness of the grouping process of the subjects in order to more accurately assess Libero Players on Teammate Physical Performance in Simulated Matches. the applicant and the researchers concerned have already accumulated a wealth of experimental experience in the previous period, and will protect the privacy and information disclosure. The applicant and the researchers have accumulated a lot of experience in the previous experiments, and will strictly protect the privacy of the applicant and the researchers.

Applicant's Commitment:

All the contents filled in above are true. If approved, I will conduct the study in strict accordance with the provided protocol and abide by the Code of Ethics for Medical and Scientific Laboratory Animals, ethical requirements and related regulations, and voluntarily accept the supervision and inspection by the Academic Committee of the university, and voluntarily accept the appropriate penalties in case of violation of the regulations.

Applicant's Signature: YONG JUN PU January 20, 2025

Review Comments:

Reviewed by the Academic Committee of the Yunan Vocational College of Transportation. Design specifications for the project. The content and process of the study are in line with the international Declaration of Helsinki and the Measures for Ethical Review of Biomedical Research Involving Human Beings (for Trial Implementation) formulated by China's health department, as well as GCP-related ethical principles, ethical standards, and relevant laws and regulations, and it is agreed that the project will be carried out according to the plan.

Yunnan Vocational College of Transportation

January 20, 2025

Academic Committee Review Comments:

1.Eligibility of applicants: ☐ Meet the requirements（√） ☐ Not up to standard

2.Experimental program: ☐ Fitting（√） ☐ Unfit

3.Conclusions of the review: ☐ Agree with（√） ☐ Revise and re-discuss ☐ Disagree

Yunnan Vocational College of Transportation Academic Committee

January 20, 2025

Appendix E

NASA-TLX measurement

Experimental group number: **Name:**

NASA Task Load Index NASA-TLX Scale

Hart and Sreveland NASA Mission Load Index evaluates workload by means of a five-digit, seven-point scale. High, medium, and low incremental values for each point respond to 21 levels.

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mental needs

How about the brainpower requirements of the task

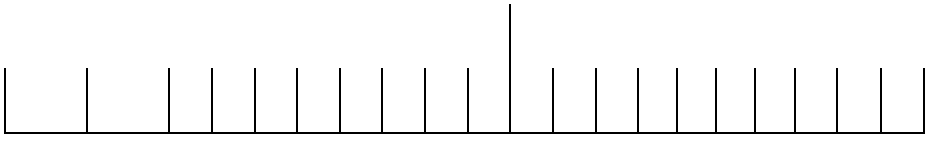
very low

very high

---

physical burden

How about the brainpower requirements of the task



very low

very high

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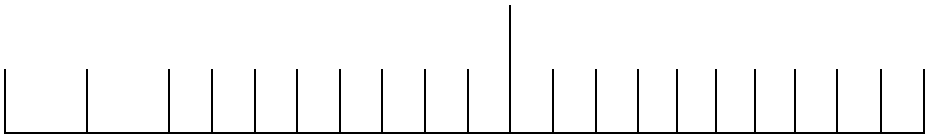
time requirement

How about the brainpower

requirements of

the task



very low

very

high

How about the

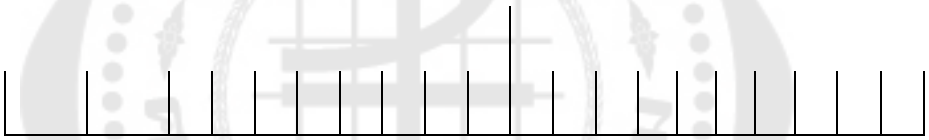
brainpower

requirements of

the task

Mission

performance



seamless

fail

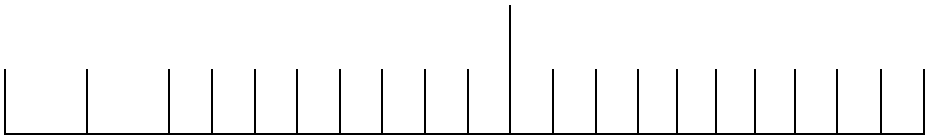
How about the

brainpower

requirements of

the task

effort



very low

very

high

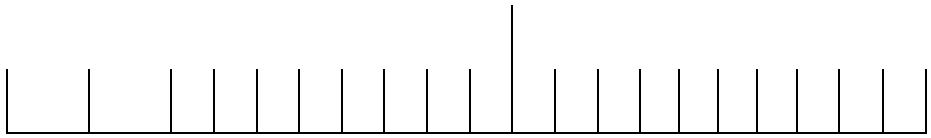
How about the

brainpower

frustration

requirements of

the task



very low

very

high

VITA