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New Training Method Approach On Perception-Awareness To Improve Sport Performance On Volleyball Athletes

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ABSTRACT

Background: Jumping ability in volleyball is a key determinant of athletic performance. While different studies focus on methods to enhance vertical jump, few address athletes' perception and awareness in conjunction with performance metrics. **Objective:** This study introduces an innovative quanti-qualitative approach, termed the perception-awareness model, to assess and enhance both physical performance and cognitive engagement in volleyball jump training. **Methodology:** Twelve young female volleyball players participated in a two-month plyometric training protocol. This quantitative and qualitative study, where the qualitative part is understood as qualitative-quantitative because the qualitative measurements can be quantified, aims to assess vertical jump performance through the Vertec test, administered at 3 times: before, during and after training. Concurrently, perception and awareness were assessed through a custom 5-point Likert scale questionnaire. Statistical analyses included repeated measures ANOVA and Wilcoxon tests, followed by a post hoc for multiple comparisons. **Results:** The results showed significant performance improvements between Pre and Mid ($p = 0.0115$) and Pre and Post ($p = 0.0196$) plyometrics training protocol. Questionnaire data revealed progressive increases in athletes' self-reported perception and awareness, with significant gains across all comparisons ($p < 0.05$). **Conclusion:** Data underscore the effectiveness of integrating perception-awareness assessments with traditional performance metrics evaluation. This model demonstrates a novel linkage between enhanced perceptual-cognitive insights and measurable improvements in vertical jump performance, highlighting its potential as a comprehensive framework for athlete development.

Key words: Surveys and Questionnaires, Plyometric Exercise, Vertical Jump, Vertec Device, Sports Performance, Athletic Training

INTRODUCTION

Volleyball is a sport that involves both technical and tactical elements (D'Elia et al., 2019), where the key factors for executing a successful play include precision, power, and strength development (Ferrara et al., 2018; D'Isanto et al., 2017). It is also considered an intermittent anaerobic team sport that involves explosive movements in both vertical and horizontal directions, interspersed with short recovery periods. (Esposito et al., 2024). Volleyball is a sport that requires skills in neuromuscular coordination (Raiola, 2014), and motor development (Giardullo, 2024) so as to be performant both in the defensive phase such as, for example, wall actions, and in the offensive phase such as batting or attacking (Castro et al., 2011; Oliinyk et al., 2021) where points can be earned (Alminni et al., 2019). The sum of these demands emphasizes the need for athletes to be well-rounded, with exceptional physical and cognitive abilities. (Raiola, 2017). A key factor influencing volleyball performance is the effectiveness of vertical jumps in executing technical actions like spiking and blocking. Improving jumping ability is one of the main goals to look for during volleyball training. As with other team sports, in volleyball, the athlete must jump higher than his or her opponent, and the act must be performed as fast as possible (Kollias et al., 2004).

The vertical jump plays a crucial role in executing the spike, block, topspin serve, and floating serve. The verti-

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cal jump is also a crucial parameter in many other sports, such as basketball and soccer, where the ability to elevate is closely linked to overall performance (Menzel et al., 2010; Spiteri et al., 2015). In particular, studies have shown that jump height is correlated with volleyball performance (Ziv & Lidor, 2010). In fact, scoring actions e.g. dunk, block and serve are mainly performed during the vertical jump (Sheppard et al., 2007; Sheppard et.al, 2009).

Motor learning and intensive training activities do not involve athletes because they are considered passively just for applying physical exercise protocols to achieve high performance at any cost. Several studies (Ceruso et al., 2024; Esposito, 2024) have shown the beneficial effect of involving athletes in training processes, demonstrating the validity of the dynamic ecological approach that applies a form of heuristic learning, where the athlete is part of the decision-making process (Raiola & Di Domenico, 2021). Therefore, in line with the principle of training specificity, volleyball players should consistently participate in jump-focused training programs to enhance their performance. (Gabbett, 2016).

Indeed, training programs targeting explosive power, such as plyometric jump training (PJT), have significantly improved jump-related metrics (Forza, J. (2019). In this regard, plyometric jump training (PJT) programs have shown to produce similar or even greater improvements in vertical jump height (VJH) in volleyball players compared to other training methods. (Newton et al., 1999; Newton et al., 2006; Ziv & Lidor, 2010.). In the search for such adaptations, plyometric training was found to be the most effective (Esposito et al., 2024). In keeping with their lent pattern, volleyball players always incorporate vertical jump drills into their training session (Silva et al., 2019; Ziv & Lidor, 2010).

There are studies in the literature demonstrating the effectiveness of plyometric protocols, for example, it was shown how a 6-week plyometric training protocol had improved the jumping performance of 14-year-old female volleyball players by 11%. (Martel et al., 2005). Plyometric training was found to be effective, not only for the 14-year-old girls, but also for the 24-year-old athletes, who underwent 8 weeks of work and experienced a 6 percent improvement in vertical jump. (Perez-Gomez et al., 2013; Baker, 1996). The purpose of plyometric training is to increase the power generated by the lengthening-shortening cycle of the myotendinous component. (Trajkovic et al., 2016).

For best results, it is advisable to refer to the Ecological-Dynamic approach. This approach is grounded in the physiological (Edelman, 1987) and psychological principles of Motor Imagery (Jeannerod, 2002) and motor control theory, where the coach creates a learning environment focused on the range of skills and plays within the variables of the phenomenon (Raiola, 2014). From the ecological perspective, "learning" refers to the gradual discovery of the most effective movement solution for a specific task within a given context (Raiola, 2014). Additionally, in this approach, learning is seen as the education of attention. (Raiola, 2014). Moreover, in this approach, learning is defined as attention education (Gibson, 1978). Learning is about optimizing perception processes and developing the ability to dictate specific stimuli (Raiola, 2012). Considering that jumping performance is greatly impacted by an individual's ability to utilize elastic and neural benefits, strong muscle development, and the speed of muscle contraction, plyometric training is anticipated to enhance athletes' jumping ability (Çankaya et al., 2018). In this context, the literature consistently indicates that plyometric training helps optimize landing mechanics (Avedesian et al., 2020), enhances eccentric muscle control, and promotes greater knee flexion and activation of the posterior thigh muscles. (Molla et al., 2023). In order to monitor an athlete, we use a fundamental tool, namely functional assessment, which is useful for determining the athlete's physical condition and creating a better training protocol with a specific workload. Coaches frequently use the vertical jump power test as a standard method to evaluate jump height and muscle power (Borràs et al., 2011). The scientific literature presents several studies on jump tests, but there seems to be a lack of research focusing on the athlete's perceptions and awareness. Consequently, no training protocols have been developed that have the main objective of improving the athlete's awareness of the activities performed.

Purpose of the research - The aim of the study is to showcase the effectiveness of the new methodological integration of perception-awareness in volleyball, specifically focused on vertical jump development, by assessing perception levels, defined as the initial acquisition of feedback, and awareness, understood as knowledge gained from personal experience.

MATERIALS AND METHODS

Participants and Study Design

The pilot study is with a single experimental group and integrates quantitative data, to evaluate the effectiveness of a jump-specific training protocol, with qualitative data of perceptions and awareness. The two distinct phases are inherent: 1) first, data collection in pre and, after the administration of the training protocol, data collection in post, through the Vertec test (Yingling et al., 2018). The latter is administered at three times: before the start of the protocol, after 6 weeks, and at the end of 12 weeks; similarly, the questionnaire is administered at the same time intervals to collect information related to the perceptions and subjective response of the intervention participants. 2) The second phase involves the administration of a questionnaire, separated into perception and awareness questions, to test the effects of strength enhancement on athletes. A defined population (P) of 12 competitive female volleyball athletes, aged between 16 and 32 years, was recruited. All participants actively compete in regional and national tournaments and meet the inclusion criteria of being active players with at least two years of competitive experience. Convenience sampling was used to select participants who were readily accessible and fulfilled these criteria, ensuring a baseline level of athletic skill and familiarity with structured training protocols.

Intervention

The intervention (I) consisted of a structured training protocol to enhance specific athletic skills relevant to competitive volleyball. The training protocol is developed over 12 weeks, divided into four weekly sessions lasting 120 minutes each. It is divided into three phases, each of which aims to achieve specific goals. 1) Weeks 1 to 4 focused on improving general muscle strength to create a solid foundation for the subsequent development of explosive power. Each session starts with a 15-minute dynamic warm-up, which includes joint mobility exercises, dynamic stretching, and neuromuscular activation. Then, there are exercises such as squats, lunges and deadlifts, performed in 3-4 sets of 6-10 repetitions at progressive load. In parallel, core strengthening exercises such as planks and Russian twists are introduced to improve stability and control during jumps. 2) It is developed from week 5 to week 8 to apply plyometric exercises of vertical jumps and box jumps to maximally stress the fast twitch muscle fibers. Each session ends with de-fatigue exercises and static stretching to promote muscle recovery and prevent injury and focuses on the development of explosive power and the ability to apply the strength gained in vertical jumping; this phase includes strength exercises with squats with overload and hip thrusts in combination with intense plyometric exercises; the latter include depth jumps (depth jumps), box jumps with progressively greater heights, and sprints with resistance. Plyometric exercises are structured in 3-4 sets of 6-10 repetitions, with an emphasis on movement quality and landing control to develop explosive strength capacity in short intervals to improve vertical jump performance. 3) It is developed from week 9 to week 12 and focuses on integrating physical and technical skills acquired in specific game situations such as jumps during wall blocking and dunk attacks, performed with maximum quick strength; sessions include simulated dunks against the wall, overload jumps, and group drills to improve coordination and synchronization with teammates. At the end of each session, athletes participate in a video analysis, which allows them to evaluate their jumping technique and identify any areas for improvement. The primary outcomes ere performance improvements in specific volleyball skills, assessed using validated performance metrics, and physiological adaptations monitored through health screenings and performance tests. These outcomes were intended to assess how effective the training protocol is in enhancing athletic performance. All participants provided informed consent before taking part in the study, which was conducted in compliance with the Declaration of Helsinki. Ethical review and approval were not required, as the study fell under the category of educational research. According to the U.S. Department of Health & Human Services' Ethical Principles and Guidelines for the Protection of Human Subjects, non-invasive innovative methods aimed solely at improving training quality may be exempt from review and approval by an Institutional Review Board (IRB) or Ethics Committee. Exclusion criteria included recent injuries (within the past three months) that could interfere with physical performance and any medical conditions contraindicating intensive physical activity. A preliminary health screening conducted by a certified sports physician confirmed the eligibility and readiness of participants to engage in the intervention. To test the level of perception and awareness in female athletes, a questionnaire, based on perception and awareness, was created and administered through Google forms and disseminated through social networks after the test administrations.

Statistical Analysis

A repeated measures ANOVA was employed to determine significant differences across the three time points for the quantitative data related to the vertical jump test results (Pre, Mid, and Post). This approach allowed for the assessment of within-group variations over the course of the training protocol. Post-hoc tests for multiple comparisons were subsequently applied to identify specific differences between the time points. Statistical significance was defined as $p < 0.05$. To analyze the questionnaire data, collected via a Likert scale, the non-parametric Wilcoxon test was applied to assess changes in perception and awareness across different stages (Pre, Mid, and Post). This method was chosen due to the ordinal nature of Likert scale data. Post-hoc tests for multiple comparisons were also performed to analyze significant findings further. As with the ANOVA, the significance threshold was set at $p < 0.05$. Its internal consistency was assessed using Cronbach's alpha and associated 95% confidence intervals (CI) to validate the survey. Perfect reliability is assured by a Cronbach's value of 1. In contrast, acceptable internal consistency is given by a cutoff value of 0.7. The distribution of responses for each question, is indicated by the descriptive statistics that have been represented in percentages. The analysis was conducted using the Statistical Package for Social Science software (IBM SPSS Statistics for Windows, version 25.0, IBM, SPSS Inc., Armonk, NY, USA).

RESULTS

The results of the pre-, mid-, and post-training Vertec Test are summarized in Table 2. These data demonstrate the progression in vertical jump performance among the participants over the course of the two-month training protocol. Table 3 presents the mean and standard deviation of the vertical jump test, carried out in the three periods.

Table 4 presents the results of the repeated measures ANOVA and subsequent post-hoc comparisons. The analysis reveals significant improvements from Pre to Mid and Pre to Post, while the difference between Mid and Post did not reach statistical significance.

Table 5 illustrates the detailed responses to the perception and awareness questionnaire at Pre, Mid, and Post stages. These results highlight changes in the athletes' self-reported perception and awareness of their vertical jump abilities and the effectiveness of the training protocol.

Table 6 represents the mean and standard deviation of the questionnaire results.

Table 7 details the results of the Wilcoxon test and post-hoc comparisons, emphasizing significant improvements in perception and awareness metrics across the training stages.

Table 1. Perceptions-awareness Questionnaire

Perception-awareness Qestionnaire	
Pre-Training Questionnaire	1. How aware are you of your current vertical jump abilities? (1=Not aware at all, 5=Very aware) 2. How much do you think your jump abilities affect your performance in training or competition? (1=Not at all, 5=Very much) 3. How important do you think it is to work on improving your vertical jump ability? (1=Not important at all, 5=Very important)
In-Training Questionnaire (after 1 month)	1. How much do you think your awareness of your vertical jump abilities has improved compared to the beginning of the training? (1=Not improved at all, 5=Very much improved) 2. How much do you think the training is currently influencing your overall performance? (1=Not at all, 5=Very much) 3. How motivated do you feel to continue the protocol to achieve further improvements? (1=Not motivated at all, 5=Very motivated)
Post-Training Questionnaire	1. How much do you think your awareness of your vertical jump abilities has improved compared to the beginning of the training? (1=Not improved at all, 5=Very much improved) 2. How satisfied are you with the way the protocol has influenced your overall performance? (1=Not satisfied at all, 5=Very satisfied) 3. How important do you think it is to continue monitoring your jump ability to maintain and further improve your performance? (1=Not important at all, 5=Very important)

Table 2. Vertical jump test scores (cm) before training (Pre), at mid-point (Mid), and after training (Post)

Vertical jump test scores (cm) before (Pre), at mid (Mid), and after (Post)			
Participant	**Pre (cm)**	**Mid (cm)**	**Post (cm)**
1	281	283	286
2	272	274	275
3	267	270	272
4	253	254	254
5	275	275	276
6	282	282	284
7	249	249	251
8	268	269	268
9	259	260	260
10	269	268	266
11	267	270	274
12	265	266	266

Table 3. Vertical jump test Descriptive statistics

Vertical jump test Descriptive statistics			
	Pre (cm)	**Mid (cm)**	**Post (cm)**
M	267.3	268.3	269.3
DS	10.0	10.2	10.8

M=Media; SD=standard deviation.

Table 4. Repeated measures ANOVA results with post-hoc comparisons

ANOVA	Comparison	t-statistic	p-value
F=6.83; *P*=0.0049	Pre vs Mid	-3.03	0.0115*
	Pre vs Post	-2.73	0.0196*
	Mid vs Post	-2.03	0.0671

* = significant difference at 0.05.

DISCUSSION

The findings of this study highlighted the effectiveness of the new methodological integration in volleyball, particularly in enhancing perception-awareness related to vertical jump performance. After two months of plyometric training, athletes showed a significant improvement in their vertical jump ability. The Vertec test results indicated an average increase in vertical jump performance from pre- to post-training, with statistically significant differences ($p < 0.05$).). These findings align with prior evidence supporting plyometric training's ability to enhance jump capacity by optimizing the stretch-shortening cycle. This cycle, which involves an eccentric contraction followed by a rapid and powerful concentric contraction, is a key mechanism for improving muscular power (Malisoux, 2006). Beyond the physical performance aspects, the study explored the perception-awareness paradigm among athletes. Data from the questionnaires revealed a significant improvement in the athletes' perception of their vertical jump abilities and their awareness of the skill's importance for overall performance. Specifically, mean scores on questions related to awareness (e.g., "How much do you think you have improved in your awareness of vertical jump abilities?") and satisfaction (e.g., "How satisfied are you with how the protocol influenced your overall performance?") increased significantly post-training (Wilcoxon, $p < 0.001$). These findings suggest that targeted protocols can enhance both physical abilities and individual awareness, an outcome supported by Babic et al., (2014), who highlighted that perceiving and internalizing stimuli provided by specific protocols enhances their effectiveness. Additionally, the high levels of satisfaction reported in the questionnaires confirm the critical role of motivation in performance improvement (Raiola et al., 2022).

The study also highlighted the importance of shared and targeted training strategies in strengthening group dynamics. Observations revealed increased personal motivation and a stronger sense of belonging among the athletes, suggesting that well-structured protocols improve individual physi-

Table 5. Perceptions and awareness questionnaire results

Perceptions and awareness questionnaire results									
Participant	**Pre_Q1**	**Pre_Q2**	**Pre_Q3**	**In_Itinere_Q1**	**In_Itinere_Q2**	**In_Itinere_Q3**	**Post_Q1**	**Post_Q2**	**Post_Q3**
1	2	2	2	3	2	2	4	3	4
2	1	2	2	2	3	3	3	4	5
3	2	2	1	3	2	1	4	4	2
4	1	2	2	1	3	2	3	4	4
5	1	2	2	2	3	2	3	5	4
6	1	2	1	2	2	2	3	4	3
7	1	2	2	1	2	2	2	3	4
8	2	1	2	3	1	3	4	2	4
9	1	1	1	1	1	2	3	2	3
10	1	2	1	1	3	1	2	4	2
11	1	1	1	2	2	1	4	3	2
12	2	2	1	2	3	2	4	5	3

Pre_Q1=Question 1 Pre protocol administration; Pre_Q2=Question 2 Pre protocol administration; Pre_Q3=Question 3 Pre protocol administration. In_Itinere_Q1=Question 1 in itinere protocol administration; In_Itinere_Q2=Question 2 in itinere protocol administration; In_Itinere_Q3=Question 3 in itinere protocol administration. Post_Q1=Question 1 post protocol administration; Post_Q2=Question 2 post protocol administration; Post_Q3=Question 3 post protocol administration.

Table 6. Perceptions and awareness questionnaire results, Media and Standard Deviation

Perceptions and awareness questionnaire results									
Results	**Pre_Q1**	**Pre_Q2**	**Pre_Q3**	**In_Itinere_Q1**	**In_Itinere_Q2**	**In_Itinere_Q3**	**Post_Q1**	**Post_Q2**	**Post_Q3**
M	1,33	1,75	1,50	1,92	2,25	1,92	3,25	3,58	3,33
SD	0,49	0,45	0,52	0,79	0,75	0,67	0,75	1,00	0,98

Pre_Q1=Question 1 Pre protocol administration; Pre_Q2=Question 2 Pre protocol administration; Pre_Q3=Question 3 Pre protocol administration. In_Itinere_Q1=Question 1 in itinere protocol administration; In_Itinere_Q2=Question 2 in itinere protocol administration; In_Itinere_Q3=Question 3 in itinere protocol administration. Post_Q1=Question 1 post protocol administration; Post_Q2=Question 2 post protocol administration; Post_Q3=Question 3 post protocol administration. M=Media; DS=standard deviation.

Table 7. Wilcoxon test results with post-hoc comparisons

Wilcoxon	Comparison	p-value
Q1	Pre vs In Itinere	0.0082
	In Itinere vs Post	0.0005
Q2	Pre vs In Itinere	0.0143
	In Itinere vs Post	0.0005
Q3	Pre vs In Itinere	0.0253
	In Itinere vs Post	0.0005

Q1: Question 1; Q2: Question 2; Q3: Question 3.

cal performance and foster group cohesion (D'Isanto et al., 2024). However, several limitations of this study should be acknowledged. The absence of a control group and the limited sample size reduce the generalizability of the findings. These factors limit the ability to draw definitive conclusions about the observed improvements. Future research should aim to include a larger, more diverse sample and incorporate control groups to enhance the validity and reliability of the results. Another limitation is the reliance on self-reported measures for perception and awareness, which may be subject to bias. Employing objective tools for assessing cognitive and perceptual changes would strengthen future investigations.

From a practical implication, the study's findings underline the importance of integrating technical and cognitive elements into training protocols. Coaches and trainers can use similar methodologies to simultaneously enhance physical performance and athlete awareness, fostering both individual and team development. Moreover, the incorporation of satisfaction and motivation metrics highlights the significance of psychological factors in athletic performance, suggesting that future training designs should consider holistic approaches that address physical, cognitive, and emotional components. This study provides a promising foundation for further exploration of the perception-awareness paradigm in sports performance. The dual emphasis on physical and cognitive improvements offers a novel approach to optimizing athletic potential. By addressing the study's limitations and building upon its strengths, future research can continue to refine and expand our understanding of this integrated methodology, ultimately contributing to more effective and comprehensive training strategies.

CONCLUSION

The results highlighted significant improvements in vertical jump performance, extending beyond mere execution to

encompass a broader perspective of athletic skill development. Perception and awareness proved fundamental to the overall growth of the athletes' abilities. This approach underscored how self-awareness and recognition of areas for improvement could provide added value in sports training. Moreover, the protocol demonstrated a positive impact on the athletes' motivation, helping to strengthen their sense of group belonging and team cohesion. This effect and physical improvements suggested that an integrated approach combining physical, technical, and cognitive aspects could represent a highly effective strategy for optimizing sports performance. It is important to emphasize that the work carried out provides a solid foundation for future research. Broader studies with more representative samples and the inclusion of a control group could further expand knowledge in this field. The ability to integrate perception, awareness, and performance represents an innovative perspective capable of enriching not only training practices but also the quality of the athletic experience.

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ETHICAL APPROVAL

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki. Ethical review and approval were waived for this study because it was an educational research study. According to the Ethical Principles and Guidelines for the Protection of Human Subjects of Research from the U.S. Department of Health & Human Services, innovative methods that are non-invasive and solely designed to enhance the quality of training might be exempt from Institutional Review Board (IRB) or Ethics Committee review and approval.

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