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ORIGINAL ARTICLE

The effect of 8 weeks of block and traditional periodization training models on practical factors in volleyball players

Mohammad Javad Tavakkoli . *Shahid Bahonar University of Kerman, Islamic Republic of Iran.*
Mahdi Abbaspoor. *Department of Exercise Physiology. Faculty of Physical Education and Sport Sciences. Shahid Bahonar University of Kerman, Islamic Republic of Iran.*
Rohollah Nikooie. *Department of Exercise Physiology. Faculty of Physical Education and Sport Sciences. Shahid Bahonar University of Kerman, Islamic Republic of Iran.*

ABSTRACT

The aim of this study was to investigate the effect of 8 weeks of traditional and block periodization training models on practical factors in volleyball players. 13 male volleyball players (mean ± SD; age: 17 ± 0.70 years; body mass: 68 ± 12.13 kg; stature: 181 ± 17.13; BMI: 20 ± 3.03) from the same team were divided in two groups (BP: 6; TP: 7). The subjects performed 3 training sessions in volleyball court per week for 8 weeks. The subjects implemented 3 testing stages (before starting, mid and after 8 weeks) including Vertical Jump, Illinois, Pro-agility and T Agility Tests, Shuttle run 300-yard, Side jumps in 60 second and, finally, Hand grip. Between-group changes were assessed using repeated measure analysis. There were not significant differences between group-time interaction effect, in Vertical jump (p > .05), Agility time (p > .05), Power endurance (p > .05) and Special aerobic endurance (p > .05). This means that there were not significant differences between the groups in improving practical training factors; but Time effect was significant (p < .05). In other words, this means that all subjects had a significant improvement in their practical training factors during the implementation of 8 weeks of the training protocol. In addition, Block periodization showed higher means in the strength of arm and forearm at the end of protocol.

Keywords: Performance analysis of sport, Volleyball, Periodization, Conditioning.

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Corresponding author. *Shahid Bahonar University of Kerman, Islamic Republic of Iran.*
E-mail: m.javadtavakkoli@yahoo.com
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INTRODUCTION

Volleyball is an intermittent sport characterized by frequent execution of brief, high-intensity activities. In volleyball, physical fitness factors such as strength, explosive power, anaerobic capacity (glycolytic) and agility are of special importance and play an important role in the success of athlete (Fischetti, Vilardi, Cataldi, & Greco, 2018; Junior, 2020; Talebi & Sabalani, 2021). The dominant energy system in the volleyball is anaerobic system called glycolytic and aerobic energy system play less important role. During competition, A volleyball player uses 90% of the anaerobic energy system (70% of the Creatine Phosphate System and 20% of the glycolytic system), and the rest is the aerobic energy system (approximately 10%) (Bompa, T. & Buzzichelli, 2015; Ramirez-Campillo et al., 2021). Each volleyball rally lasts about 1 to 10 seconds, after which, the athlete has between 11 and 30 seconds to rest and start the game again, That all the physical factors (strength, explosive power, anaerobic capacity (glycolytic) and agility) play an important role in volleyball rallies (Gielen, Mehuys, Eyckmans, & Aerts, 2020; Junior, 2020; Reeser & Bahr, 2017; Sheppard, Gabbett, & Riggs, 2012; Weldon et al., 2021). This issue is well known that for the success of athletes, resistance training should be included, based on special strategies, in athletes' annual plans aimed at improving physical factors and minimizing overtraining through. These strategies can be referred to as athletes' training periodization that are important for progress, development and break the training plateau (Arazi, Khoshnoud, Asadi, & Tufano, 2021; Fisher & Csapo, 2021; Gavanda, Geisler, Quittmann, & Schiffer, 2019). The first and most common periodization developed for the training of athletes was the traditional periodization, also known as linear periodization in Western literature.

In the traditional periodization, macrocycles and mesocycles are planned in such a way that training are moved from high volume and low intensity to low volume and high intensity (Bompa, T.O., & Buzzichelli, 2019; Fleck & Kraemer, 2014; Mcguigan, 2017). A distinctive feature of traditional periodization is that the athlete can develop all the fitness factors simultaneously, and this can be a good way to improve the athlete's performance factors at the same time (Bartolomei, Hoffman, Merni, & Stout, 2014; Bompa, T.O., & Buzzichelli, 2019). Block periodization, in the other hand, it differs from traditional periodization by focusing on the minimum training factors in each mesocycle. In block periodization, at least one or two physical fitness factors are practiced in each mesocycle, as opposed to traditional periodization. More precisely, the main purpose of block periodization is to focus on practicing the minimum physical fitness factors continuously in each mesocycle (Issurin, V., 2008; Issurin, V. B., 2010, 2016; Mcguigan, 2017).

Previous studies have investigated the effect of block periodization on physical and practical factors in other sports, but according to the studies investigated by researcher, no research has been found on the effect of block periodization on physical fitness and practical factors in volleyball. In a study worked on the effect of block periodization on performance factors in the Spanish Professional Football League (speed endurance, anaerobic capacity), the results showed that block periodization significantly increased speed endurance and anaerobic capacity of Spanish Football League players (Mallo, 2011). In another study worked on basketball players, the effect of block and traditional periodization on jumping performance and speed of basketball players, the results showed that block periodization has a significant effect on increasing the explosive power of basketball players, but on the speed performance, changes between the two groups was not significant (Pliauga et al., 2018).

In traditional periodization, alternatively, a study done by Hassan Tammam and colleagues in 2016, comparing the effect of linear and biweekly non-linear periodization on maximum strength and vertical jump in volleyball players in Egypt, found that biweekly non-linear periodization outperformed the linear periodization model making larger improvements in maximal strength, and a little higher percentage increase

in vertical jump than linear periodization model (Hassan Tammam & Mohamed Hashem, 2016)., To date, Therefore, according to the studied investigated by researcher, no sufficient researches has been found on the effect of block and traditional periodization on volleyball performance factors. Therefore, the aim of the present study was to investigate the effects of block and traditional periodization on physical and practical factors in volleyball players.

MATERIALS AND METHODS

Participants

13 male volleyball players (mean ± SD; age: 17 ± 0.70 years; body mass: 68 ± 12.13 kg; stature: 181 ± 17.13; BMI: 20 ± 3.03) (14 volleyball players totally voluntarily participated in this research but one of the players omitted from the research because of the onset of Corona virus symptoms), from the same team were selected and divided in two groups. All subjects had at least one year of training experience and had no injuries. Before starting the protocol, the subjects became fully familiarized with the place of training, testing, as well as the type of protocol. Also, the testing process was explained to the subjects in great detail and the subjects did not perform high intensity exercises 48 hours before the testing session.

Study design

In this study, individuals were divided into traditional periodization (n = 7) and block periodization (n = 6). Periodization were independent variables and dependent variables were Vertical jump, T-Agility, IIlinois, Pro-agility, Shuttle run 300 yard, 60-second side jump, and hand grip tests to assess forearm and arm muscle strength. Athletes were conducted and trained by the researcher as a conditioning and strength coach and an international volleyball coach.

Training periodization models

The training protocol and the type of training factor performed per session for the two groups of traditional and block periodization are shown in Table 1.

Table 1. Training protocol and type of training factor performed per session for the two groups of traditional and block periodization.

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
The first microcycle (week 1-2)							
Block	Rest	AE	Rest	AE	Rest	AE	Rest
Traditional	Rest	AE+VSAE	Rest	PA	Rest	PAE	Rest
The second microcycle (week 3-4)							
Block	Rest	PAE	Rest	PAE	Rest	PAE	Rest
Traditional	Rest	AE+VSAE	Rest	PA	Rest	PAE	Rest
The third microcycle (week 5-6)							
Block	Rest	VSAE	Rest	VSAE	Rest	VSAE	Rest
Traditional	Rest	AE+VSAE	Rest	PA	Rest	PAE	Rest
The fourth microcycle (week 7-8)							
Block	Rest	PA	Rest	PA	Rest	PA	Rest
Traditional	Rest	AE+VSAE	Rest	PA	Rest	PAE	Rest

Note. AE = aerobic endurance, PEA = power-agility endurance, VSAE = volleyball-special aerobic endurance, PA = power-agility.

The two groups of traditional and block periodization performed 3 training sessions per week for 8 weeks. Also, the exercises were the same for both groups for 8 weeks and in each training factor. In the block

periodization group, in the first two weeks the focus of training was on improving aerobic endurance, in the second two weeks the focus of training was on power and agility endurance, in the third two weeks the focus of training was on volleyball-special aerobic endurance and in the fourth two weeks the focus of training was on explosive power and agility. In the traditional periodization group, in the other hand, the subjects performed all the training factors simultaneously per week. All the subjects, both groups, became familiarized with training protocol. In the aerobic endurance training sessions, the players practiced running, walking and fartlek for 45 minutes. Intensity of exercises in aerobic sessions was programmed by the method of rating of perceived exertion (RPE) and between 5 and 8 score, which means that the subjects exercised with moderate to high intensity. In the power and agility endurance training sessions, athletes performed power and agility exercises that simulated tactical and technical skills in competition after warming up for 20 minutes. Exercises were performed in 2 sets with repetitions between 8 to 10 repetitions. The duration of activity in each repetition was between 8 to 15 seconds and the rest time between repetitions was 10 to 25 seconds (rest time between sets was 5 minutes). Also, in the power and agility endurance training sessions, people performed the exercises with their maximum effort. In the volleyball-special aerobic endurance training session, the subjects performed volleyball-specific aerobic exercises in the form of tactical and technical skills for 45 minutes of which 20 minutes were devoted to the warm-up protocol. Intensity of training in volleyball special aerobic training sessions was programmed based on the individual's maximum effort. Thus, all the exercises were performed in a duration of 20 to 30 seconds in 3 to 4 sets and a rest period of 2 to 3 minutes between sets. In the power and agility training sessions, the subjects began training after warming up for 20 minutes. Exercises were performed in 3 sets with 5 repetitions per set. The duration of each repetition was between 4 and 8 seconds and the rest period between repetitions was 1 to 3 minutes (the rest period between sets was 5 minutes). The cool down protocol was performed for all training sessions in two groups for 10 to 15 minutes. Also, the intensity and volume of training sessions were the same for both groups.

Performance testing

Testing process was performed in 3 stages (before the beginning of the protocol, mid-protocol (after 4 weeks) and after the end of the protocol (after 8 weeks)). All the test items were performed 48 hours after the end of the last training session. Before each test, the subjects performed the test items experimentally and in the direction of learning, and they were given full explanations on how to perform the test. Also, the subjects implemented the warm-up protocol for 20 minutes before starting the testing process. The Jumping tester JS-D80 Yagami Japan was used for Vertical jump test. At the time of performing the Vertical jump test, the subjects' knee angle was approximately 80 to 90 degrees. After first touching the device and determining the height, the subjects jumped with their maximum power and touched the highest point of the device and the number shown on the monitor of the device showed the height of the jump. Training cones and a stopwatch were used to implement T, Illinois and Pro-agility tests (Haff, G., & Triplett, N.T., 2017). And the time of doing the test was recorded by the researcher in a special sheet. To assess volleyball-special aerobic endurance using Shuttle run 300 yard (Haff, G., & Triplett, N.T., 2017). In this way, the two training cones were placed on the ground at a distance of 25 yards from each other and each subject performed 6 full round trips and then the time spent by the subject was recorded in a special sheet by the researcher. Side jump test in 60 seconds was used to assess power endurance. To do the test. The subject stood next to a 12-inch-high hurdle and jumped on the hurdle for 60 seconds at the instructor's command, and when the time was up, the number of jumps was recorded in the special sheet.

Finally, to assess the strength of forearm and hand muscles, hand grip test was used with Dynamometer 100 kg Yagami Japan. In the first step, the subject adjusted the height of the handle and then pressed the handle upwards and held it in the same position for 5 seconds. The number shown on the screen of the device

showed the strength of the subject's hand and forearm muscles in KG. Also, all tests were taken from the subjects 3 times to accurately record the information.

Statistical analysis

Descriptive statistics were used to analyse the data. In the descriptive statistics section, the research findings were presented as the mean ± standard deviation and the required graphs were drawn using Excel software. Then, to evaluate the normality and homogeneity of the data, Shapiro–Wilk and Levene's test were used. After ensuring the normality and homogeneity of the data, inferential statistics were used. Repeated measurement test was used to compare time and group-time effect in three different time periods. All statistical steps were performed using SPSS version 26. Also, the results were plotted in Excel 2016.

RESULTS

The results of the research are then reported as the group-time and the time effect. The results were as follows: there is no significant difference between the effect of block and traditional periodization on explosive power ($p > .05$) (Figures 1 and 2), agility time ($p > .05$) (Figures 3, 4, 5, 6, 7, 8), power endurance ($p > .05$) (Figures 9 and 10) and volleyball-special aerobic endurance ($p > .05$) (Figures 11 and 12). This means that the group-time interaction effect is not significant. But the time effect alone is significant and the subjects in both groups improved their physical and practical factors for 8 weeks ($p < .05$).

Figures 1 and 2 showed the group-time and the time effect on explosive power. As reported, the average explosive power of the subjects improved after 8 weeks compared to baseline.

Figures 3 and 4 showed the group-time and the time effect on the T agility test. The mean of T agility test was reported to decrease after 8 weeks (improved performance).

Figures 5 and 6 showed the group-time and the time effect on the pro-agility test. The mean of pro-agility test was reported to decrease after 8 weeks (improved performance).

Figures 7 and 8 showed the group-time and the time effect on the Illinois agility test. The mean of Illinois agility test was reported to decrease after 8 weeks (improved performance).

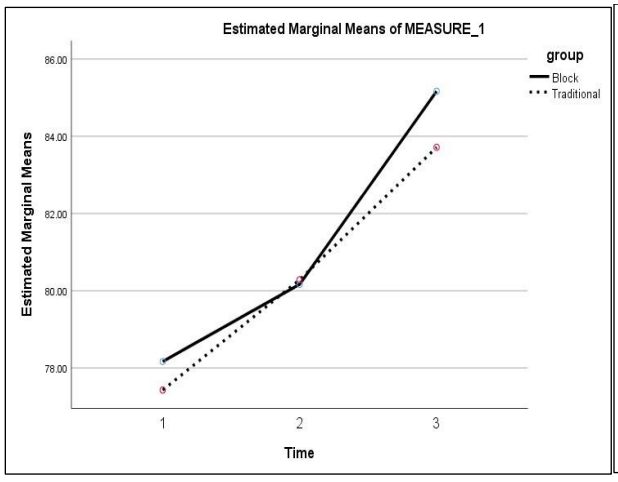

Figure 1. Group-time on explosive power.

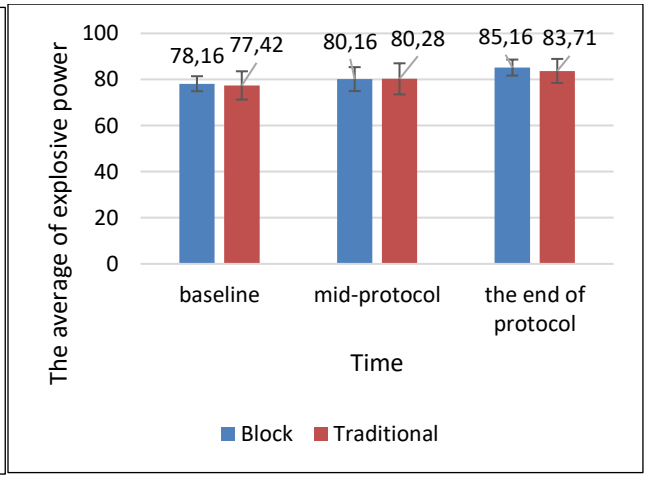

Figure 2. Time effect on explosive power.

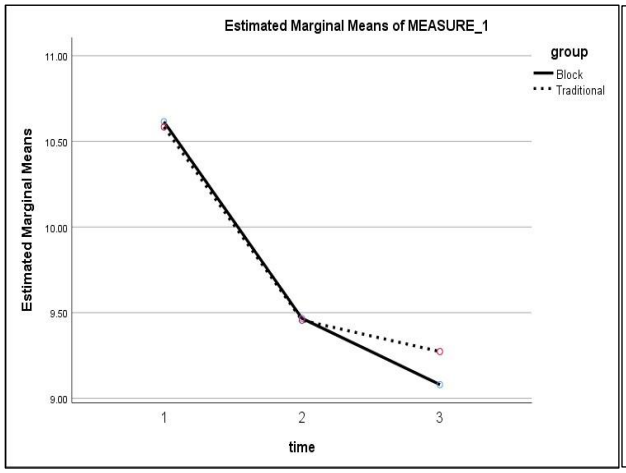

Figure 3. Group-time on the T agility test.

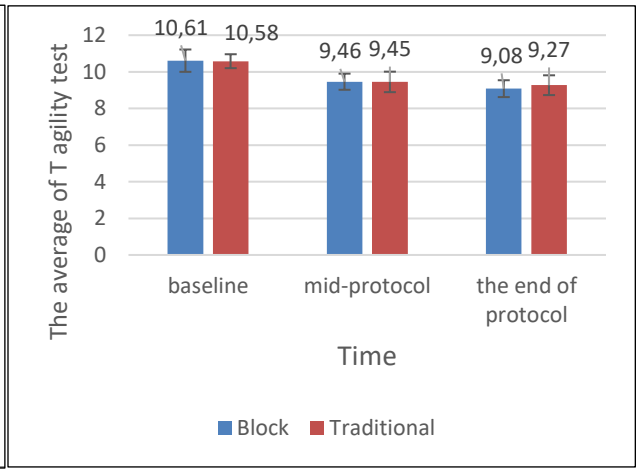

Figure 4. Time effect on the T agility test.

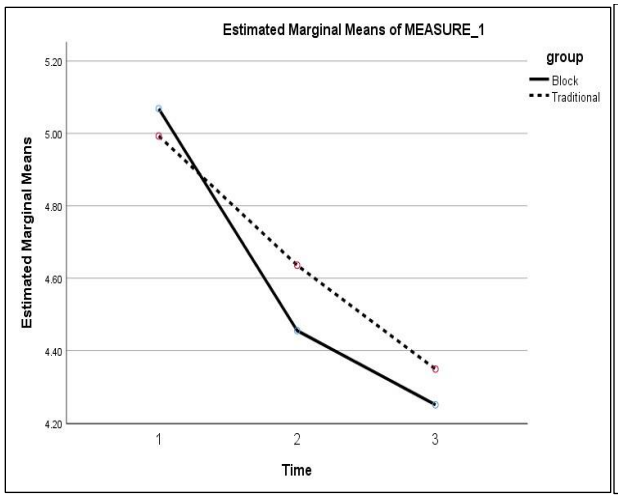

Figure 5. Group-time on the pro-agility test.

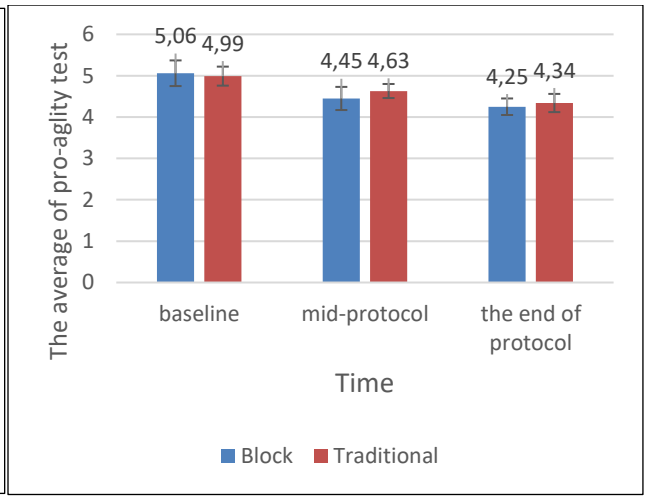

Figure 6. Time effect on the pro-agility test.

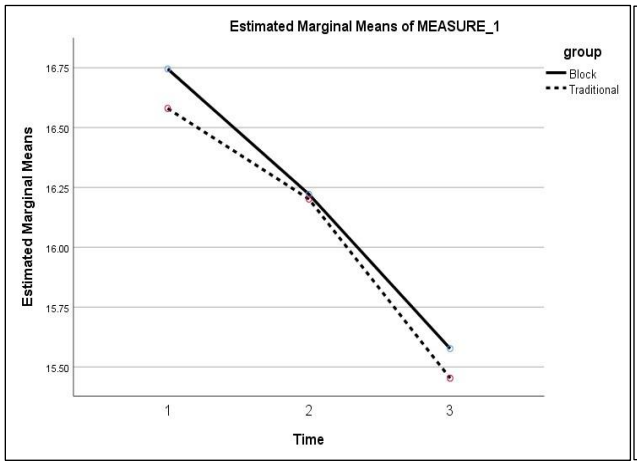

Figure 7. Group-time on the Illinois agility test.

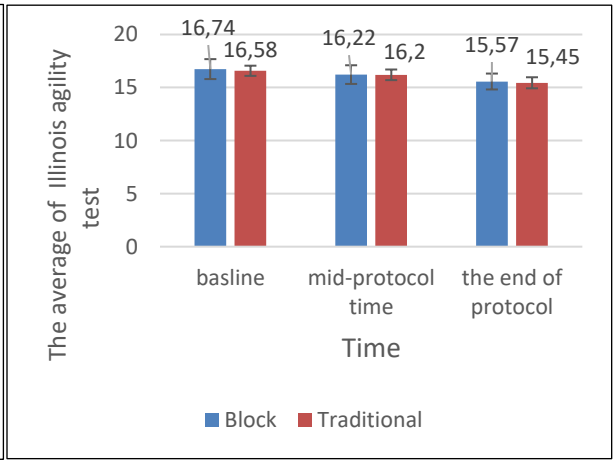

Figure 8. Time effect on the Illinois agility test.

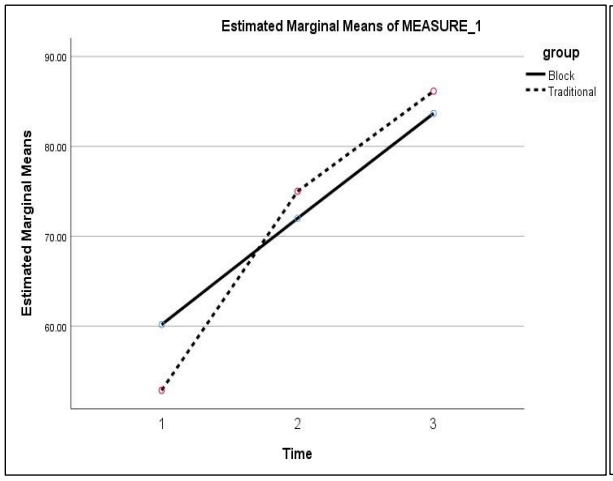

Figure 9. Group-time on the side jump test.

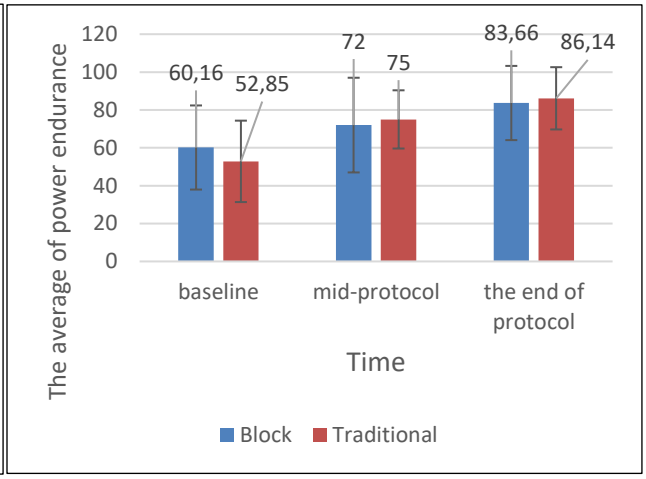

Figure 10. Time effect on the side jump test.

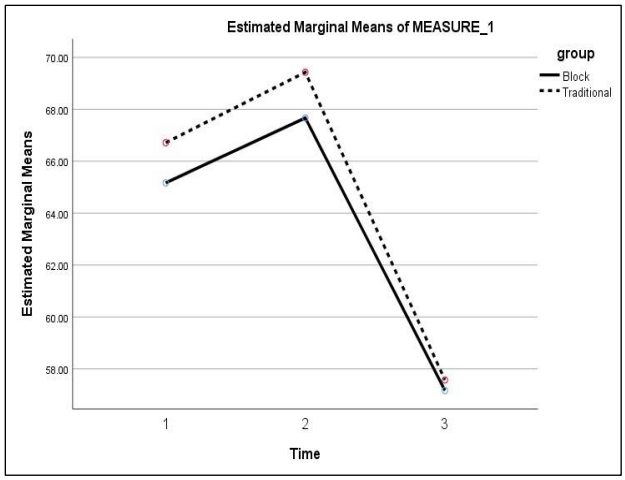

Figure 11. Group-time on the aerobic endurance test.

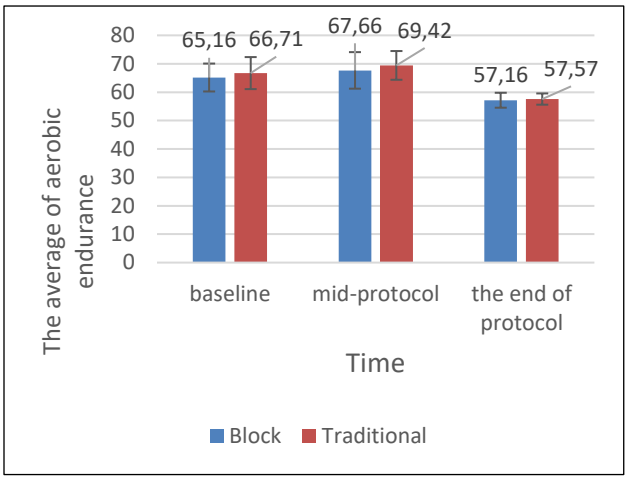

Figure 12. Time effect on the aerobic endurance test.

Figures 9 and 10 showed the group-time and the time effect on the side jump test. As reported, the average side jump test was incremental after 8 weeks.

Figures 11 and 12 showed the group-time and the time effect on the aerobic endurance test. The mean of aerobic endurance test was reported to decrease after 8 weeks (improved performance).

DISCUSSION

The aim of this study was to investigate the effect of traditional and block periodization training models on practical factors in volleyball players. The research findings showed that in Vertical, considering that after 8 weeks, the block group had a higher average in jump height than the traditional group, but the differences between the two groups were not significant. In agility performance, the block group in T-test and Pro-agility tests had a lower mean after 8 weeks than the Illinois test. In Illinois test, the traditional group has a lower average after 8 weeks. However, according to the reported data, the difference between the two groups in agility performance was not significant. About power endurance, the traditional group had a higher mean than

the block group after 8 weeks of training. But the difference between the two groups was not significant and the two groups improved the power endurance factor almost equally. In the special aerobic endurance factor measured by the shuttle run test, no difference was observed between the two groups after 8 weeks of training. In a 2014 study done by Hoffman et al, on the effect of block and traditional periodization on upper and lower body strength in trained individuals, the results showed that both periodization increased upper and lower body strength. However, there was no difference between the groups in increasing the lower body strength, and the reason for this was probably the lack of plyometric exercises and the similarity of the exercises to the testing tests in the research (Bartolomei et al., 2014). In another study by Scalen et al, on the traditional and block periodization in basketball players, the results showed that both periodization improve the explosive power of basketball players. However, this improvement in the block periodization group has been somewhat greater, and the reason for this improvement can be considered as more emphasis in the first weeks of training, which is the basis of training for athletes, and this has increased the performance capacity of players (Pliauga et al., 2018).

One of the reasons for the improvement in power in the block group was the emphasis on the first weeks of training (accumulation phase) and the residual training effect and the similarity of training to the tests taken (Issurin, V., 2008). Therefore, it has been shown that exercise frequency has a great effect on improving performance and it is true in block periodization (Ratamess et al., 2009). A study investigating block periodization in specific judo exercises did not show a significant improvement in explosive power because the exercises were not similar to squat and countermovement jump tests taken, but in tests related to judo techniques. The subjects had a significant improvement in their performance (Marques, Franchini, Drago, Aoki, & Moreira, 2017).

Also, in another study that investigated block periodization and its effect on strength, power and mean power in 2019, the results showed that block periodization (a combination of resistance and plyometric exercises) is more superior to traditional periodization in improving the named factors above (Doina & Florina, 2019). A 2021 study done by Zuzana et al. Found that when agility exercises were a simulation of the main competing skills, individuals had a significant improvement in agility performance, which reduced agility time (Kovacikova & Zemková, 2021). In a review article worked by Maria on agility training in volleyball in 2022, it was shown that all exercises that are in the nature of power and agility, have a great impact on improving the performance of agility. In addition, T agility test has been one of the most widely used tests to evaluate agility performance in articles (Bonato, De Capitani, & Banfi, 2022). In the block periodization in the first weeks, a lot of emphasis was placed on power and agility training, which has likely led to an improvement in agility performance after 8 weeks of training. An 11-week study examined individuals' training status in block periodization. The results showed that block periodization improved the power, strength and performance of the subjects (Wetmore et al., 2020). Since the tapering process was planned on all training factors, especially agility and power in the last sessions, the improvement in agility time can also be applied to this issue. This is because the physiological elements in the tapering process, by reducing the volume of training and changing the isoforms of the myosin heavy chain, it has a significant effect on increasing the power and in turn the agility of athletes (Wetmore et al., 2020). Since the glycolysis system is of special importance in the power endurance factor, and volleyball gets 20% of the its energy from the glycolysis system, based on this issue, the researches has shown that block periodization can affect anaerobic capacity and in turn Improve athletes' performance (Arroyo-Toledo, Clemente, & González-Rave, 2013; Mallo, 2011). A study examined the block periodization of strength and endurance training in ice hockey athletes. The results showed that planning exercises as a block periodization has a greater advantage over traditional periodization for athletes, which can be considered as more focus on training factors in each block (Rønnestad, B. R., Øfsteng, & Ellefsen, 2019). One of the reasons for improving aerobic performance in the special aerobic endurance

factor can be considered as the basis of training based on the principles of gradual overload in training phases. In block periodization in the early weeks, the emphasis was on aerobic endurance and in the final weeks the predominant focus was on improving anaerobic capacity with lactic exercise, which improved athletes' performance. Research has shown that continuous aerobic and anaerobic training and training frequency play an important role in improving the anaerobic capacity of individuals, especially, volleyball players (Nasuka, Setiowati, & Indrawati, 2020; Ratamess et al., 2009) that is true in block periodization.

A 2012 study on the effect of block periodization of high-intensity aerobic exercise on cyclists found that high-intensity exercise, especially in the first weeks of exercise, improved maximal oxygen consumption and power output (Rønnestad, B., Hansen, & Ellefsen, 2014).

CONCLUSIONS

Selecting the traditional or block periodization for planning volleyball players' training, can improve the practical and physical factors of volleyball players. However, according to the reported results, block periodization may be more effective than traditional periodization in improving volleyball players' training factors, especially explosive power, due to their greater adaptability to training (type of periodization structure) and the creation of better residual training effects; Therefore, coaches must carefully choose the type of periodization model for their athletes.

AUTHOR CONTRIBUTIONS

Mohammad Javad Tavakkoli: conception and design, editing the manuscript. Mahdi Abbaspoor: data collection, analysis, and interpretation. Rohollah Nikooie: drafting and writing the manuscript.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

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