

**ANALYSIS OF CHANGES IN SELECTED PHYSICAL FITNESS VARIABLES
DURING A PERIODIZED TRAINING YEAR OF MALE
KHO KHO PLAYERS**

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ABSTRACT

The aim of the current study was to obtain data of changes during a periodized training year on selected physical fitness variables in male Kho Kho players. The subjects employed in the present study were twelve male Kho Kho players. Testing took place at four points during the periodized training year; at the beginning of general preparation (T1), specific preparation (T2), competition phase beginning (T3) end of competition phases of training and peaking (T4). The physical fitness variables selected for the investigation are speed, explosive power and muscular strength. The repeated measures of analysis of variance (ANOVA) indicated significant differences between testing sessions for speed, explosive power and muscular strength. *Post-hoc* analysis revealed the significant differences for speed, explosive power and muscular strength. Analysis revealed the significant differences for speed existed between T1-T3, T1-T4, T2-T3 and T2-T4, for explosive power between T1- T3, T1-T4 and T2-T4, for muscular strength between T1-T4 differences in post-hoc analysis. The percentage reduction for speed between T1-T3, T1-T4, T2-T3 and T2-T4 were 4.47%, 4.93%, 3.58% and 4.04% respectively. The increase in explosive power between T1- T3, T1-T4, and T2-T4 were 16.78%, 18.08%, and 11.59% respectively. The increase in muscular strength between T1-T4 was 5.62% respectively.

Key words: *Kho Kho, Physical Fitness, Speed, Explosive Power, Muscular Strength, Training year.*

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Introduction

Kho-Kho is considered to be one of the most popular traditional sports in India and it is played quite extensively in the country. The origin of Kho-Kho is difficult to trace, but many historians believe, that it is a modified form of 'Run Chase', which in its simplest form involves chasing and touching a person. With its origins in Maharashtra, Kho-Kho in ancient times, was played on 'raths' or chariots, and was known as RATHERA. This game is simple, inexpensive and enjoyable. This can be played by men, women and even children. It is essentially a version of tag, which endows it with a few qualities. It is both simple, and inexpensive that make the game as enduring as it is endearing. Inside are some of the salient features of the game to enable you to appreciate and understand it. The game of Kho-kho is based on natural principles of physical and mental development, is vigorous and fosters a healthy combative spirit among the youth. Kho- Kho demand physical fitness, strength, speed and endurance, and a certain amount of agility. Dodging, feinting and bursts of controlled speed make this game quite thrilling. To catch by pursuit to chasing,, rather than just run is the capstone of Kho- Kho. The game develops psychological qualities such as obedience, discipline, sportsmanship, and loyalty between team members.

Training variation is increasingly acknowledged as serving a key function in successful training prescriptions (**Fleck, 1999**). Periodization offers a framework for planned and systematic variation of training parameters, in a way that directs physiological adaptations to the training goals required of the sport (**Brown, and Greenwood 2005**). Accordingly, training studies typically find periodized training to elicit improved training responses in comparison to training groups employing a constant load throughout the study period (**Stone et al 2000**). Consensus has thus largely been reached among researchers and practitioners that periodized training offers superior development of strength, power, speed and other performance variables.

An annual training plan, consisting of a hierarchy of time periods and distinct fitness phases, is the yearly plan that outlines the competition schedule, projected testing sessions, and planned recovery periods. While the terms used to categorize these time periods may slightly differ among authors, an annual training plan is organized into distinct cycles: the macrocycle (long-length cycle), the mesocycle (middle-length cycle), the microcycle (short-length cycle), and the training session [**Haff and Triplett 2015**]. While periodization and programming are difficult to separate, they each focus on different aspects of the training process. Periodization introduces variation through cyclical phases and time periods, while programming consists of structuring the training variables (load, sets, repetitions, and exercise selection) within the phases to enhance the training effect [**DeWeese et al 2015**]. This study was focused on the kho kho players as the game is popular and played throughout the world. Studies observing the effect of training on selected physical fitness variables of university kho kho players are popular in India. In view of the above, a study was undertaken to investigate the effect of training on physical fitness variables changes in male kho kho players.

MATERIALS AND METHODS

Subjects

The subjects employed in the present study were twelve male kho kho players from Annamalai University team (Mean \pm SD: Age 22.0 ± 2.4 years, Height 168.7 ± 7.9 cm, Body Mass 65.9 ± 6.1 kg) preparing for the 2019 South Zone Inter University Kho Kho tournament. All the players had been part of the team for a minimum of 2 years. The study was approved by the Departmental Ethics Committee and the players provided written, informed consent to participate. All subjects were familiar with all the testing that took place, which included both field and laboratory assessments.

Testing Procedure

Testing took place at four points during the periodized training year; at the beginning of general preparation (T1), specific preparation (T2), competition phase beginning (T3) end of competition phases of training and peaking (T4). A full testing battery was conducted at T1 and T4, while two minor testing sessions were conducted at T2 and T3. A schematic of the periodized year can be found in Table- 1.

Table 1.

A schematic representation of the periodized training year of the Annamalai University Kho Kho team. The different training phases, as well as the testing points are presented.

Marc h	April	May	June	July	August	September	October	November
General preparation			Specific preparation			Competition phase		Competition Peak
T1			T2			T3		T4

The study commenced after the end of the previous competitive season and at the beginning of the general preparation phase of training. The training year was divided into three mesocycles (general preparation, March to May; specific preparation, June to August; competition, September to November). The players trained daily and thus it is not possible to quantify exact training loads. The battery of tests utilized was based on selected Physical fitness variables, comprising both laboratory and sport-specific protocols. All subjects were familiarized with the procedures prior to testing. Sport-specific testing had been used frequently as part of the training programme, while for the laboratory-based tests the subjects undertook specific familiarization trials prior to the testing sessions. The subjects had been instructed to refrain from strenuous exercise for forty-eight hours prior to testing and to avoid food and caffeine intake for two hours preceding the assessments. All subjects completed testing at the same time of day to avoid any circadian rhythm effects [Atkinson and Reilly (1996)].

Variables and Tests

The physical fitness variables and tests selected for the study Table-2

Table-2

S.No	Variables	Tests/Measures
1	Speed	Fifty meter dash
2	Agility	Shuttle run
3	Muscular Strength	Leg Strength

Statistical technique

The collected data was analyzed using descriptive statistics, and were calculated for all variables. A repeated measures analysis of variance (ANOVA) was utilized to determine significant differences for each variable between the testing sessions. When F is significant Scheffe's test was applied as post hoc test to determine the paired mean difference if any. The value of 0.05 was set for statistical significance.

Result of study

Table-3

Tab: 3: Results on Repeated Analysis of Variance on Physical fitness Variables

Calculation of Repeated Analysis of Variance on Speed								
Means \pm SD on Completion of Different Phases				Source of Variance	Sum of Squares	df	Means Squares	F-Ratio
T1 (GPP)	T2(SPP)	T3(CPB)	T4(CPP)					
6.48 \pm 0.20	6.42 \pm 0.23	6.19 \pm 0.13	6.16 \pm 0.11	A (Factor)	0.832	1	0.832	24.20
				Error	0.378	11	0.034	
				B (Tests)	0.920	3	0.307	10.31
				Error	0.981	33	0.030	
Calculation of Repeated Analysis of Variance on Explosive Power								
47.1 \pm 5.0	50.8 \pm 5.06	56.6 \pm 4.49	57.5 \pm 5.09	A (Factor)	814.01	1	814.01	74.94
				Error	120.01	11	30.81	
				B (Tests)	868.91	3	289.63	11.62
				Error	822.58	33	24.92	
Calculation of Repeated Analysis of Variance on Muscular strength								
92.4 \pm 4.03	93.7 \pm 3.88	96.6 \pm 4.20	97.8 \pm 4.43	A (Factor)	152	1	152	7.24
				Error	230	11	20.99	
				B (Tests)	168.39	3	56.13	3.38
				Error	547.85	33	16.60	

Table value required for significance at 0.05 level with df 1, 11 & 3, 33 were 4.84 and 2.89 respectively. General preparation (T1), Specific preparation (T2), Competition phase beginning (T3), End of competition phases of training and peaking (T4)

Descriptive (mean \pm SD) of the results can be found in Table 3. Repeated measures of analysis of variance (ANOVA) indicated significant differences between testing sessions for speed ($F = 10.31$, $P = 0.001$), explosive power ($F = 11.62$, $P = 0.001$) and muscular strength ($F = 3.38$, $P = 0.006$). *Post-hoc* analysis revealed that the significant differences for speed existed between T1-T3, T1-T4, T2-T3 and T2-T4 for explosive power between T1-T3, T1-T4 and T2-T4, for muscular strength between T1-T4 difference in post-hoc analysis. The percentage reduction for speed between T1-T3, T1-T4, T2-T3 and T2-T4 were 4.47%, 4.93%, 3.58% and 4.04% respectively. The increase in explosive power between T1-T3, T1-T4, and T2-T4 were 16.78%, 18.08%, and 11.59% respectively. The increase in muscular strength between T1-T4 was 5.62% respectively.

Discussion

The results of study showed that there was significant decrease in speed noted among university level kho kho players when comparing the T1 – T3, T1-T4, T2-T3, and T2- T4 phases. When comparing speed of T3-T4 phase no significant difference was noted among university level kho kho players. There are many studies in support of findings of the present study. **Mara et al., (2015)** have suggested sprint performance over 15 m improved by 2.8% ($P=.013$) after preseason training, while 25-m-sprint performance peaked at midseason, with a 3.1% ($P=.05$) improvement from the start of preseason, before declining at the end of season ($P=.023$). Training demands varied between phases, with total distance and high-speed distance greatest during preseason before decreasing ($P<.001$) during the early- and late-season phases. **De Hoyo et al (2016)**, have found that strength training methods used in this study seem to be effective to improve jumping and sprinting abilities, but change of direction might need other stimulus to achieve positive effects. **Harries et al (2018)**, have found that resistance training increases lower-body strength in adolescent rugby union players and increases in lower-body strength may transfer to improved sprinting performance with improvements after daily undulating periodized resistance training slightly superior. **Comfort and other (2012)**, have proved that the improvements in sprint performance came as a direct consequence of increased strength or whether both are a function of the strength and power mesocycles incorporated into the players' preseason training is unclear. It is likely that the increased force production, noted via the increased squat performance, contributed to the improved sprint performances. **Sakti Ranjan and Bibhuti Bhusan (2012)** have found specific pre season training programme for 4 week/ 8 week or 12 weeks duration enhanced the agility, speed and explosive power of the players significantly. But 12 week participation in the specific pre-season training package had marked maximum gain on the agility, speed and explosive power of the volleyball players.

The results of study showed that there was significant decrease in explosive power noted among university level kho kho players when comparing the T1 – T3, T1-T4 and T2- T4 phases. When comparing explosive power of T2-T3 and T3-T4 phase no significant difference was noted among university level kho kho players. There are many studies in support of findings of the present study. **Hoffman et al., (2009)** have found that the traditional linear periodization program group had significant strength and power improvements week 1-week 8 with the 1RM Bench Press and Squat. Vertical jump was also tested throughout the 15 week cycle. The subjects had a small increase in strength from weeks 8-15. Vertical jump, vertical jump power and Medicine Ball throw increased significantly as well. **Gonzalez, Arija**

&Clemente-Suarez (2011) have showed that the subjects various vertical jump maximises increased throughout the study from 4.4- 7.5%, even while in season. Maximum strength the back squat (2RM) increased by 6.67% from pre to post with the subjects. **Panbilnathan and Balamuruan (2012)** have proved that explosive power was significantly improved at intensive and in-season phases comparing the initial scores. It was concluded that the different phases of training can be utilized for motor fitness variables among university level kabaddi players. **Argus et al (2012)**, have suggested that high-level rugby union athletes should be exposed to higher volume-load contrast training which includes one heavy lifting session each week for larger and more uniform adaptation to occur in explosive power throughout a competitive phase of the season. **Barjaste and Mirzaei (2018)**, have indicated that muscle strength and explosive performance in players with little experience in resistance training can significantly improve following the completion of general phase of resistance training periodization using moderate loads.

The results of study showed that there was significant decrease in muscular strength noted among university level kho kho players when comparing the T1-T4 phase. When comparing explosive power of T1-T2, T2-T3, T2- T4 and T3-T4 phases no significant difference was noted among university level kho kho players. There are many studies in support of findings of the present study. **Kerksick et al (2009)** have proved that 8 week training significantly increased maximal strength on the 1RM of the bench press and leg press with all subjects. **Harries, Lubans & Callister (2015)** have showed that 16 of the studies increased maximal strength significantly with linear periodization and nonlinear periodization. Within the 16 studies, 12 studies showed no significant difference in maximal strength between the two periodization programs. **Kyriazis et al (2009)**, have suggested that muscular power of the lower extremities is a better predictor of rotational shot put performance than absolute muscular strength in skilled athletes, at least during the competition period. **Indranil Manna and others (2011)** have found significant increase ($P<0.05$) in grip and back strength have been noted in preparatory phase and competitive phase when compared to baseline data of the players after the training. This study would provide useful information for training and selection of soccer players of under-19-year-old groups.

Conclusion

The present study was to examine the physical fitness changes of kho kho players over the course of a periodized training year. The results demonstrated that significant alteration in speed, explosive power and maximum strength occurred as the training year progressed. This would enable the coaches to assess an athlete's current status and the degree of training adaptability and provide an opportunity to modify the training schedule accordingly to achieve the desired performance.

REFERENCES

1. Atkinson, G., and T. Reilly. 1996. Circadian variation in sports performance. *Sports Medicine*, 21: 292-312.
2. Baechle TR, Earle RW, (2008). *Essentials of strength training and conditioning*. Champaign: Human Kinetics.

3. Barjaste A, Mirzaei B. (2018), “The periodization of resistance training in soccer players: changes in maximal strength, lower extremity power, body composition and muscle volume”. *J Sports Med Phys Fitness*. Vol- 58(9):1218-1225.
4. Bartolomei S, Hoffman JR, Merni F, (2014). A comparison of traditional and block periodized strength training programs in trained athletes. *J Strength Cond Res*. 28(4):990–7.
5. Brown, L.E., and M. Greenwood,(2005) . Periodization essentials and innovations in resistance training protocols. *Strength Cond. J*. 27(4):80–85.
6. Chiu, L.Z.F., and J.L. Barnes. (2003). The fitness-fatigue model revisited: Implications for planning short- and long- term training. *Strength Cond. J*. 25(6): 42–51.
7. Comfort P, Haigh A, Matthews MJ. (2012),” changes in maximal squat strength during preseason training reflected in changes in sprint performance in rugby league players”. *J Strength Cond Res*. Vol- 26(3):772-6.
8. De Hoyo M, Gonzalo-Skok O, Sanudo B, Carrascal C, Plaza-Armas JR, Camacho-Candil F, Otero-Esquina C. (2016), “Comparative Effects of In-Season Full-Back Squat, Resisted Sprint Training, and Plyometric Training on Explosive Performance in U-19 Elite Soccer Players”. *J Strength Cond Res*. Vol- 30(2):368-77.
9. DeWeese B, Gray H, Sams M, (2013). Revising the definition of periodization: merging historical principles with modern concern. *Olympic Coach*. 24:5–19.
10. DeWeese BH, Hornsby G, Stone M, (2015). The training process: planning for strength–power training in track and field. Part 1: theoretical aspects. *J Sport Health Sci*. 2015;4(4):308–17.
11. DeWeese BH, Hornsby G, Stone M, (2015). The training process: planning for strength–power training in track and field. Part 2: Practical and applied aspects. *J Sport Health Sci*. 4(4):318–24.
12. Fleck, S.J. (1999). Periodized strength training: A critical review. *J. Strength Cond. Res*. 13(1):82–89.
13. Gonzalez-Rave, J. M., Arija, A., & Clemente-Suarez, V. (2011). Seasonal changes in jump performance and body composition in women volleyball players. *The Journal of Strength & Conditioning Research*, 25(6), 1492-1501.
14. Haff GG, Triplett NT, (2015). *Essentials of strength training and conditioning*. 4th ed. Champaign: Human Kinetics;
15. Harries SK, Lubans DR, Buxton A, MacDougall THJ, Callister R. (2018), “Effects of 12-Week Resistance Training on Sprint and Jump Performances in Competitive Adolescent Rugby Union Players”. *J Strength Cond Res*. Vol- 32(10):2762-2769.
16. Harries, S. K., Lubans, D. R., & Callister, R. (2015). Systematic Review and Meta-analysis of Linear and Undulating Periodized Resistance Training Programs on Muscular Strength. *Journal of Strength and Conditioning Research*, 29(4), 1113-1125.
17. Harries, S. K., Lubans, D. R., & Callister, R. (2015). Systematic Review and Meta-analysis of Linear and Undulating Periodized Resistance Training Programs on Muscular Strength. *Journal of Strength and Conditioning Research*, 29(4), 1113-1125.
18. Hoffman, J. R., Ratamess, N. A., Klatt, M., Faigenbaum, A. D., Ross, R. E., Tranchina, N. M., Kraemer, W. J. (2009). Comparison between Different Off-Season Resistance Training Programs in Division III American College Football Players. *The Journal of Strength and Conditioning Research*, 23(1), 11-19.
19. Indranil Manna, Gulshan Lal Khanna, Prakash Chandra Dhara,(2011). Effect of

- Training on Morphological, Physiological and Biochemical Variables of U-19 Soccer Players *Baltic Journal of Health and Physical Activity* Volume 3, No 4, 237-247.
20. Issurin V, (2008). Block periodization versus traditional training theory: a review. *J Sports Med Phys Fit.* 48(1):65.
 21. Issurin VB, (2010). New horizons for the methodology and physiology of training periodization. *Sports Med.* 40(3):189–206.
 22. Karavirta, L., Hakkinen, A., Sillanpaa, E., García-Lopez, D., Kauhanen, A., Haapasaari, A., & Häkkinen, K. (2011). Effects of combined endurance and strength training on muscle strength, power and hypertrophy in 40- 67-year-old men. *Scandinavian Journal of Medicine & Science in Sports*, 21(3), 402-411.
 23. Kenney WL, Wilmore JH, Costill DL, (2011). *Physiology of sport and exercise.* 5th ed. Champaign: Human Kinetics;
 24. Kerksick, C. M., Wilborn, C. D., Campbell, B. I., Roberts, M. D., Rasmussen, C. J., Greenwood, M., & Kreider, R. B. (2009). Early-Phase Adaptations to a Split-Body, Linear Periodization Resistance Training Program in College- Aged and Middle-Aged Men. *Journal of Strength and Conditioning Research*, 23(3), 962-971.
 25. Kraemer WJ, Ratamess NA, (2004). Fundamentals of resistance training: progression and exercise prescription. *Med Sci Sports Exerc.* 36(4):674–88.
 26. Kyriazis TA, Terzis G, Boudolos K, Georgiadis G. (2009), “Muscular power, neuromuscular activation, and performance in shot put athletes at pre-season and at competition period” . *J Strength Cond Res.* Vol- 23(6):1773-9.
 27. Mara JK, Thompson KG, Pumpa KL, Ball NB. (2015). “Periodization and physical performance in elite female soccer players”. *Int J Sports Physiol Perform.* Vol -10(5):664-9.
 28. Panbilnathan.Aranga and Balamurugan K.V., “Motor Fitness Changes During Different Phases of Training Among University Kabaddi Players”, *Journal of Physical Education and Allied Health Science*, Vol-2, No-1, 2012, p.50-54.
 29. Sakti Ranjan Mishra and Bibhuti Bhusan Mishra, The Effect of Specific Pre Season Training Package on Selected Physical Fitness Variables. *International Journal of Physical Education, Fitness and Sports*, Vol.1. No.4.Dec 2012:PP,45-56.
 30. Siff MC, (2003). *Supertraining.* Denver: Supertraining Institute.
 31. Smith, R. A., Martin, G. J., & Szivak, T. K. (2014). The Effects of Resistance Training Prioritization in NCAA Division I Football Summer Training. *Journal of Strength and Conditioning Research*, 28(1), 14-22.
 32. Stone MH, O’bryant HS, Schilling BK, (2000). Periodization: effects of manipulating volume and intensity. Part 1. *Strength Cond J.* 49(2):56–62.
 33. Stone MH, Stone M, Sands WA,(2007). *Principles and practice of resistance training.* Champaign: Human Kinetics;
 34. Stone, M.H., J.A. Potteiger, K.C. Pierce, C.M. Proulx, H.S. O’bryant, R.L. Johnson, and M.E. Stone, (2000). Comparison of the effects of three different weight-training programs on the one repetition maximum squat. *J. Strength Cond. Res.* 14(3):332–337.
 35. Wathen, D., T.R. Baechle, and R.W. Earle, (2000). Training variation: Periodization. In: *Essentials of Strength Training & Conditioning* (2nd. ed.). Baechle and Earle (eds.). Champaign, IL: Human Kinetics, pp. 513–527.