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Effect of fartlek training on cardiovascular endurance and explosive power among collegiate female Kho-Kho players

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Abstract
Background: Kho-Kho is an intermittent sport that requires repeated running, acceleration, changes of direction and explosive movements. These demands place considerable stress on cardiovascular endurance and lower-limb power. Fartlek training uses changes in running speed and intensity and may therefore be useful for conditioning Kho-Kho players.
Objective: To determine the effect of Fartlek training on cardiovascular endurance and explosive power among collegiate female Kho-Kho players aged 18–23 years.
Methods: A pre-test/post-test experimental study was conducted among 20 collegiate female Kho-Kho players selected by purposive sampling. Cardiovascular endurance was assessed using the 12-Minute Cooper Test and explosive power using the Standing Broad Jump Test. Participants completed a structured Fartlek training programme four days per week. Pre- and post-training scores were compared using a paired t-test, with statistical significance set at $p < 0.05$.
Results: The mean distance in the 12-Minute Cooper Test increased from 2056.00 m before training to 2510.75 m after training, giving a mean improvement of 454.75 m. The paired t-test showed a statistically significant difference ($t = 15.287$, $df = 19$, $p < 0.001$). Standing broad jump performance increased from a mean of 1.4565 m to 1.8545 m, with a mean improvement of 0.3980 m; the paired t-test was also statistically significant ($t = 13.747$, $df = 19$, $p < 0.001$).
Conclusion: The findings suggest that the Fartlek training programme was associated with significant improvements in cardiovascular endurance and explosive power in this group of collegiate female Kho-Kho players. Fartlek training may be considered as a conditioning option for improving these physical fitness components.

Keywords: Fartlek training, cardiovascular endurance, explosive power, Kho-Kho, female athletes, Cooper 12-minute run test, standing broad jump

Introduction
Kho-Kho is a fast-paced Indian team sport in which players repeatedly chase, evade, accelerate and change direction. The game therefore requires a combination of endurance, speed, agility, coordination and explosive lower-limb performance. Earlier work on Kho-Kho players has highlighted the contribution of physical fitness characteristics to playing ability [1, 4].
Fartlek training, meaning "speed play", involves continuous exercise with deliberate changes in pace. A session may include jogging, faster running, sprinting and active recovery. Because the intensity changes throughout the session, the method places demand on both aerobic and anaerobic energy systems. This makes it potentially relevant to intermittent sports in which athletes repeatedly shift between lower- and higher-intensity activities [5, 17, 18, 20, 21].
Cardiovascular endurance reflects the capacity of the cardiovascular and respiratory systems to supply oxygen to working muscles during sustained activity. The 12-Minute Cooper Test is a practical field test in which the participant covers as much distance as possible in 12 minutes and the distance achieved is used as an indicator of aerobic endurance [7, 9].
Explosive power refers to the ability to produce force rapidly. In Kho-Kho, rapid push-offs, acceleration, jumps and dives depend on effective lower-limb force production. The Standing Broad Jump is a simple field measure of horizontal explosive performance and was selected as the outcome measure in the present study [10, 11].
Although Fartlek training has been investigated in several sporting populations, the source material for this study identified comparatively limited research focused specifically on collegiate female Kho-Kho players. The present study was therefore undertaken to examine whether a structured Fartlek programme could improve cardiovascular endurance and explosive power in this population.

Objective
To determine the effect of Fartlek training on cardiovascular endurance and explosive power among collegiate female Kho-Kho players.

Methods
Study design and setting
A pre-test/post-test experimental study was conducted at the K.G. Playground, K.G. College of Physiotherapy, Coimbatore, Tamil Nadu, India.

Participants and sampling
Twenty collegiate female Kho-Kho players were selected using purposive sampling. Participants were aged 18–24 years and had been actively participating in Kho-Kho for at least one year.

Eligibility criteria
Inclusion criteria were: healthy active collegiate Kho-Kho players with at least one year of participation; age 18–24

years; collegiate-level participation; voluntary participation; and female sex. Exclusion criteria included respiratory problems, congenital deformities, severe cardiac disease, neurological or musculoskeletal conditions, unwillingness to participate, recent lower-limb fracture or injury, recent surgery, and other conditions that could interfere with participation

Variables and outcome measures

The independent variable was Fartlek training. The dependent variables were cardiovascular endurance and explosive power. Cardiovascular endurance was assessed using the Cooper 12-Minute Run Test, with total distance recorded in metres. Explosive power was assessed using the Standing Broad Jump Test, with the best of three trials recorded in metres.

Procedure

After selection according to the eligibility criteria, written informed consent was obtained. Baseline measurements were recorded before the training programme. Participants then completed the prescribed Fartlek training sessions four days per week. Post-test measurements were obtained using the same outcome measures after completion of the training programme.

The training session included a 10-minute warm-up, a variable-intensity Fartlek running component and a 10-minute cool-down. The programme progressed from an adaptation phase to a development phase and then to a performance phase. Running drills included fast running, moderate running, jogging or walking for active recovery, short sprints, changes of direction, zig-zag running and pole-touch simulations. The protocol documented in the study materials specifies a 12-week programme, four sessions per week, with each session lasting approximately 45–60 minutes.

Fartlek training protocol

Phase	Fast / sprint running	Recovery / moderate running	Progression
Weeks 1–4	30 s fast run	1 min moderate + 1.5 min slow jog/walk	6–8 cycles; 60–70% HRmax
Weeks 5–8	45 s fast run	1 min moderate + 1 min slow jog/walk	8–10 cycles; 70–80% HRmax
Weeks 9–12	1 min sprint	1 min moderate + 30–45 s slow jog/walk	10–12 cycles; 80–90% HRmax

Ethical Consideration

The study received approval from the Institutional Ethics Committee of K.G. College of Physiotherapy, Coimbatore. Participants provided written informed consent before participation.

Statistical analysis

Pre-test and post-test values were compared using a paired t-test. Statistical significance was accepted at $p < 0.05$. The participant-level values in the study master chart were used to calculate the paired t-tests reported below.

Results

Twenty participants completed the assessment set. The participants were aged 18–24 years. The age distribution and BMI distribution are presented in Tables 1 and 2.

Table 1: Age distribution of participants

Age group (years)	N	%
18–20	9	45
21–23	11	55
Total	20	100

Table 2: BMI distribution of participants

BMI (kg/m²)	N	%
19.0–20.99	8	40
21.0–22.99	6	30
23.0–25.99	6	30
Total	20	100

Table 3: Pre-test and post-test cardiovascular endurance

Measure	Pre-test mean (m)	Post-test mean (m)	Mean difference (m)	Paired t-test
Cooper 12-Minute Run Test	2056.00	2510.75	454.75	$t(19) = 15.287$, $p < 0.001$

The mean Cooper test distance increased by 454.75 m after the intervention. The paired t-test indicated a statistically significant pre- to post-test difference.

Table 4: Pre-test and post-test explosive power

Measure	Pre-test mean (m)	Post-test mean (m)	Mean difference (m)	Paired t-test
Standing Broad Jump	1.4565	1.8545	0.3980	$t(19) = 13.747$, $p < 0.001$

Standing broad jump distance increased by 0.3980 m after training. The paired t-test demonstrated a statistically significant pre- to post-test difference.

Discussion

The present study found significant improvements in both cardiovascular endurance and explosive power after the Fartlek training programme. The increase in Cooper test distance indicates that the participants were able to sustain a greater running distance during the 12-minute test after the intervention.

The observed improvement in cardiovascular endurance is consistent with earlier reports describing beneficial effects of variable-intensity running on aerobic conditioning. Fartlek training repeatedly moves the athlete between faster efforts and active recovery. This pattern can provide a substantial cardiovascular stimulus while also exposing the athlete to changes in exercise intensity that resemble the intermittent nature of team sports [17, 18, 20, 21].

Explosive power also improved, as shown by the increase in Standing Broad Jump performance. Although the programme was primarily running-based, its repeated fast runs, short sprints and accelerations required rapid force production from the lower limbs. These demands may have contributed to improved neuromuscular coordination and the ability to produce force quickly. Previous research cited in the study has similarly reported improvements in explosive performance following Fartlek or other variable-intensity conditioning approaches [26, 29].

The findings are particularly relevant to Kho-Kho because players repeatedly accelerate, decelerate, change direction and perform explosive actions during play. Improving endurance may help players tolerate repeated efforts, while improved lower-limb power may support rapid starts, changes of direction and jumping or diving actions.

The results should nevertheless be interpreted cautiously. The study used a small sample and a single-group pre-test/post-test design, so changes cannot be attributed to Fartlek training with the same confidence as in a randomized controlled trial. In addition, factors such as diet, recovery, sleep and other physical activity were not controlled.

Conclusion

A structured Fartlek training programme was associated with significant improvements in cardiovascular endurance and explosive power among the collegiate female Kho-Kho players included in this study. Fartlek training may therefore be incorporated into conditioning programmes when the aim is to develop endurance together with repeated high-intensity running ability and lower-limb explosive performance.

Limitations

The study had a small sample size and included only collegiate female Kho-Kho players. The intervention period was relatively short. Only cardiovascular endurance and explosive power were assessed, while diet, rest, recovery and daily physical activity were not controlled. The absence of a separate control group limits the ability to determine whether the observed changes were solely due to the intervention.

Recommendations

Future studies should recruit larger samples, include a control or comparison group, use longer intervention periods, and examine additional performance variables such as speed, agility, repeated-sprint ability and sport-specific performance. Studies comparing Fartlek training with other conditioning methods may also help determine the most effective approach for collegiate Kho-Kho players.

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