

Effect of a Structured Exercise Programme on Physical Fitness Among Transgender Females: A Quasi-Experimental Study

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Abstract

Background: Transgender females may experience unique physiological and social challenges that influence physical fitness and overall health. Structured exercise programmes may help improve fitness outcomes; however, evidence in this population remains limited.

Objective: To evaluate the effect of a structured exercise programme on physical fitness among transgender females.

Methods: A quasi-experimental single-group pre–post interventional study was conducted among 30 transgender females aged 18–50 years. Participants completed a supervised 10-week structured exercise programme comprising warm-up, aerobic training, resistance exercises, agility drills, flexibility exercises, and cool-down. Physical fitness outcomes were assessed before and after the intervention using the Wingate Anaerobic Power Test, T-Shuttle Run, and sit-and-reach test. Pre- and post-intervention comparisons were performed using paired t-tests.

Results: Significant improvements were observed in all physical fitness outcomes following the intervention. Wingate anaerobic power increased from 420.5 ± 85.3 W to 488.7 ± 80.6 W ($p < 0.001$). T-shuttle run performance improved significantly, with completion time decreasing from 12.8 ± 1.9 seconds to 10.6 ± 1.4 seconds ($p < 0.001$). Flexibility improved from 21.6 ± 4.1 cm to 26.8 ± 3.9 cm ($p < 0.001$). Wingate fatigue index also improved significantly ($p < 0.001$).

Conclusion: The structured exercise programme significantly improved physical fitness among transgender females. These findings support the role of supervised exercise interventions as an effective strategy to enhance health and functional performance in this population.

Keywords: Transgender females; Physical fitness; Structured exercise; Wingate test; Agility; Flexibility; Quasi-experimental study

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Introduction

Transgender individuals are persons whose gender identity differs from the sex assigned to them at birth. (1) Among them, transgender females, who are individuals assigned male at birth and who identify and live as females, represent a population with unique physiological, psychological, and social health needs. (7) In recent years, increasing attention has been directed toward improving healthcare and wellbeing among transgender communities; however, research on physical fitness and exercise interventions in transgender females remains limited. (8) Physical fitness is a key component of overall health and includes attributes such as muscular strength, endurance, flexibility, agility, and anaerobic capacity. Higher levels of physical fitness are associated with reduced risk of chronic disease, improved functional independence, better mental health, and enhanced quality of life. (2) Regular exercise is widely recognized as an effective strategy for improving these fitness components across diverse populations.

For transgender females, physical fitness may be influenced by multiple factors, including reduced participation in sports and exercise due to stigma or

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discrimination, lower access to inclusive fitness environments, and physiological changes related to gender-affirming hormone therapy. Hormonal treatment may alter body composition, muscle mass, hemoglobin levels, and metabolic responses, all of which may influence exercise capacity and training adaptation. (3) Despite these considerations, evidence suggests that transgender females can achieve meaningful fitness improvements when provided with appropriate and supervised exercise programmes. (4) Existing studies involving transgender populations have largely focused on policy issues, hormone therapy, or sports participation, with comparatively fewer studies examining structured exercise interventions and objective fitness outcomes. (5) Furthermore, available research often relies on limited fitness measures, leaving gaps in understanding how targeted training influences anaerobic power, agility, and flexibility in transgender females. (6) A structured exercise programme that combines aerobic conditioning, resistance training, agility drills, and flexibility exercises may provide significant benefits for physical performance and functional health in this population. (9) Identifying effective exercise strategies is important not only for

rehabilitation professionals and fitness practitioners but also for promoting inclusive and evidence-based health interventions for transgender communities.

Therefore, the present study aimed to evaluate the effect of a structured exercise programme on physical fitness among transgender females using standardized measures of anaerobic power, agility, and flexibility.

Methods

Study Design and Setting

This study employed a quasi-experimental, single-group pre-post interventional design to evaluate the effect of a structured exercise programme on physical fitness among transgender females. The study was conducted at Mahatma Gandhi Medical College and Research Institute, Puducherry. The total study duration was three months, with the intervention implemented over ten weeks.

Participants

A total of 30 self-identified transgender females aged 18–50 years were recruited using a convenient sampling technique. Participants with a body mass index (BMI) between 18.0 and 29.9 kg/m² and without contraindications to exercise were included in the study. Individuals were required to provide written informed consent prior to participation. Participants were excluded if they had metabolic syndrome, psychiatric disorders, cardiovascular disease, respiratory problems, neurological disorders, musculoskeletal conditions affecting exercise participation, or concurrent involvement in another structured physical activity programme during the study period.

Outcome Measures

Physical fitness was assessed before and after the intervention using standardized outcome measures. Anaerobic power was evaluated using the Wingate Anaerobic Power Test. Agility was assessed using the T-Shuttle Run test. Flexibility was measured using the sit-and-reach test.

Intervention Procedure

All participants underwent a supervised structured exercise programme for ten weeks. Each session consisted of three phases: a 10-minute warm-up involving dynamic stretching and light cardiovascular activity, a 30–40 minute main exercise session, and a 5–10 minute cool-down including static stretching and breathing exercises. The programme followed a progressive training model. Initial sessions focused on familiarization, movement coordination, and foundational strength exercises such as bodyweight squats, calf raises, and marching drills. Subsequent sessions emphasized lower limb strengthening, agility, movement speed, and core stability through resistance exercises, cone drills, shuttle movements, line hops, and ladder drills. Later stages of the programme included higher-intensity conditioning and explosive exercises such as jump squats, sprint intervals, burpees, circuit

training, and functional power drills to enhance anaerobic performance and agility. The final week was dedicated to post-intervention physical fitness assessment.

Data Collection Procedure

Baseline demographic and physical fitness data were collected prior to the intervention. Participants attended supervised exercise sessions throughout the ten-week period, and attendance was monitored regularly. Post-test assessments were conducted after completion of the programme using the same outcome measures administered at baseline. All assessments were performed by trained physiotherapists using standardized procedures. Data were recorded in structured data collection forms and entered into a secure database for analysis.

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Mean and standard deviation were used to summarize continuous variables. Pre- and post-intervention differences in physical fitness outcomes were assessed using the paired t-test. A p-value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS or equivalent software.

Ethical Considerations

The study was conducted after obtaining appropriate Institutional Ethics Committee approval. Written informed consent was obtained from all participants prior to enrolment, and confidentiality of participant data was maintained throughout the study.

Results

Participant Characteristics

A total of 30 transgender female participants successfully completed the structured exercise programme, indicating good retention throughout the intervention period. The demographic profile of the participants is presented in Table 1. Most participants belonged to the age group of 25–34 years (63.3%), followed by 18–24 years (23.3%) and 35–44 years (13.4%). This distribution suggests that the study predominantly involved young and early middle-aged adults, who may represent an active age group with greater readiness to participate in structured physical activity programmes.

With regard to marital status, the majority of participants were unmarried (80.0%), while 20.0% were married. In terms of educational qualification, 40.0% had completed secondary school education, 36.7% were graduates, and 23.3% were postgraduates, reflecting a varied educational background within the sample. Hormone therapy was reported by 60.0% of participants, whereas 40.0% had not undergone hormone therapy at the time of the study.

Table 1. Demographic characteristics of participants (N = 30)

Variable	Category	n	%
Age Group (years)	18–24	7	23.3
	25–34	19	63.3
	35–44	4	13.4
Marital Status	Unmarried	24	80.0
	Married	6	20.0
Education Level	Secondary School	12	40.0
	Graduate	11	36.7
	Postgraduate	7	23.3
Hormone Therapy	Yes	18	60.0
	No	12	40.0

Physical Fitness Outcomes

Marked improvements were observed in all measured physical fitness parameters following completion of the ten-week structured exercise programme (Table 2). The findings indicate that the intervention was effective in enhancing anaerobic performance, endurance, agility, and flexibility among transgender female participants.

Wingate anaerobic power increased significantly from 420.5 ± 85.3 W at baseline to 488.7 ± 80.6 W after the intervention, with a mean improvement of 68.2 W ($p < 0.001$). This increase reflects enhanced short-duration high-intensity power output and suggests improved muscular performance and anaerobic capacity. Such gains may be attributed to the progressive resistance, sprint, and explosive training components included in the programme.

The Wingate fatigue index showed a significant reduction from $43.1 \pm 5.8\%$ to $38.4 \pm 5.2\%$, with a mean difference of -4.7% ($p < 0.001$). A lower fatigue index indicates improved ability to sustain power output during high-intensity exercise and reflects better

anaerobic endurance and recovery efficiency. This finding suggests that participants developed greater tolerance to intense physical exertion over the intervention period.

Agility, assessed using the T-Shuttle Run test, improved significantly as completion time decreased from 12.8 ± 1.9 seconds to 10.6 ± 1.4 seconds, with a mean difference of -2.2 seconds ($p < 0.001$). Reduced shuttle run time indicates faster directional changes, better coordination, and enhanced movement speed. These improvements are likely related to the agility drills, cone exercises, and shuttle-based training incorporated into the programme.

Flexibility also demonstrated a statistically significant improvement. Sit-and-reach scores increased from 21.6 ± 4.1 cm at baseline to 26.8 ± 3.9 cm post-intervention, with a mean gain of 5.2 cm ($p < 0.001$). This increase suggests improved hamstring and lower back flexibility, which may contribute to better posture, movement efficiency, and reduced risk of musculoskeletal injury.

Table 2. Physical fitness outcomes before and after intervention (N = 30)

Parameter	Pre-test Mean \pm SD	Post-test Mean \pm SD	Mean Difference	p-value
Wingate Anaerobic Power (W)	420.5 ± 85.3	488.7 ± 80.6	+68.2	<0.001*
Wingate Fatigue Index (%)	43.1 ± 5.8	38.4 ± 5.2	-4.7	<0.001*
T-Shuttle Run Time (sec)	12.8 ± 1.9	10.6 ± 1.4	-2.2	<0.001*
Sit-and-Reach Flexibility (cm)	21.6 ± 4.1	26.8 ± 3.9	+5.2	<0.001*

Overall, the results clearly demonstrate that the structured exercise programme had a significant positive effect on multiple domains of physical fitness among transgender females. The combination of progressive strengthening, agility training, conditioning, and flexibility exercises appears to have contributed to meaningful improvements in functional performance and exercise capacity.

*Statistically significant at $p < 0.05$.

Discussion

The present study evaluated the effect of a structured exercise programme on physical fitness among transgender females. The findings demonstrated significant improvements in anaerobic power, fatigue resistance, agility, and flexibility following the ten-week intervention. (10) These results suggest that a supervised and progressive exercise programme can effectively enhance multiple components of physical fitness in this population. A significant increase in Wingate anaerobic

power was observed after the intervention, indicating improved ability to generate high-intensity muscular power over short durations. (11) Anaerobic power is an important indicator of functional performance and is closely associated with lower limb strength, neuromuscular efficiency, and overall exercise capacity. The improvement noted in the present study may be attributed to the inclusion of resistance exercises, sprint drills, jump training, and circuit-based conditioning, all of which are known to stimulate muscular adaptation

and power development. (12) The significant reduction in Wingate fatigue index further indicates improved anaerobic endurance and greater resistance to fatigue during maximal effort tasks. (13) This suggests that participants were able to sustain power output more effectively after training. Such adaptations may result from repeated exposure to interval-based exercise and progressive conditioning, which enhance energy system efficiency and recovery mechanisms. (14)

Agility, as measured by the T-Shuttle Run test, also improved significantly following the intervention. Faster shuttle run performance reflects better speed, coordination, directional control, and dynamic balance. (15) These outcomes are likely linked to the agility drills, cone-based movements, ladder exercises, and shuttle running tasks incorporated into the programme. Improved agility is clinically meaningful, as it contributes to better movement confidence, functional independence, and participation in physical activities. Flexibility showed a significant increase after the intervention, as evidenced by higher sit-and-reach scores. Improved flexibility may be explained by the regular warm-up, stretching, mobility exercises, and cool-down activities included in each session. Adequate flexibility is essential for maintaining joint range of motion, reducing movement restrictions, and lowering the risk of musculoskeletal discomfort or injury.

The findings of this study are consistent with previous literature demonstrating that structured exercise programmes improve strength, endurance, mobility, and overall physical performance across diverse populations. Although research specifically involving transgender females remains limited, available evidence suggests that transgender individuals are capable of achieving substantial fitness gains when provided with inclusive, supervised, and individualized exercise opportunities. These findings are particularly relevant because transgender females may experience barriers to physical activity, including social stigma, lack of access to inclusive exercise environments, and physiological changes related to gender-affirming hormone therapy. Hormonal therapy may influence muscle mass, body composition, and exercise performance; however, the present results indicate that meaningful physical fitness improvements are still achievable through regular training.

The practical implications of this study are noteworthy. Structured exercise programmes may be integrated into transgender healthcare, rehabilitation, and community wellness initiatives to promote physical health and functional capacity. Supervised programmes delivered in supportive environments may also improve exercise adherence and confidence among participants. Certain limitations should be considered. The study employed a single-group pre-post design without a control group, which limits causal interpretation. The sample size was relatively small, and the intervention duration was limited to ten weeks. Therefore, the findings should be interpreted with caution when generalizing to broader populations.

Future studies using randomized controlled designs, larger samples, and longer follow-up periods are recommended. Further research may also explore the influence of hormone therapy status, training intensity, and long-term exercise adherence on physical fitness outcomes. In conclusion, the present study demonstrates that a structured exercise programme can significantly improve physical fitness among transgender females. The observed gains in anaerobic power, fatigue resistance, agility, and flexibility highlight the value of exercise as an accessible and effective intervention to enhance health and functional performance in this population.

Conclusion

The present study concludes that a structured exercise programme significantly improved physical fitness among transgender females. Participants demonstrated notable gains in anaerobic power, fatigue resistance, agility, and flexibility following the ten-week intervention. These findings indicate that supervised and progressive exercise training can effectively enhance functional performance and overall physical health in transgender females, despite potential physiological and social barriers to physical activity. The results further support the role of exercise as a safe, accessible, and non-pharmacological strategy for improving fitness outcomes in this population.

Integrating structured exercise programmes into transgender healthcare, rehabilitation, and community wellness settings may contribute to better health promotion and reduced physical health disparities. Further large-scale and long-term studies are recommended to confirm these findings and strengthen evidence-based exercise guidelines for transgender populations.

Ethics Approval and Consent to Participate

The study was reviewed and approved by the Institutional Scientific Review Board, School of Physiotherapy, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry (Project No. BPT/ISRB/2025/030; dated 21 June 2025). Written informed consent was obtained from all participants prior to enrolment. All procedures were conducted in accordance with institutional guidelines and the ethical principles of research involving human participants.

Availability of Data and Materials

The data used and analyzed in the current study were collected directly from participants after obtaining appropriate Institutional Ethics Committee approval and informed consent. The datasets are available from the corresponding author on reasonable request, subject to ethical and confidentiality considerations.

Competing Interests / Conflict of Interest

The authors declare that they have no competing interests.

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Authors' Contributions

Author 1: Conceptualization, methodology, data collection, analysis, manuscript drafting.

Author 2: Study supervision, methodology review, manuscript editing.

Author 3 & 4: Statistical analysis, interpretation of results, manuscript revision, Literature review, data validation, final approval of manuscript.

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