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EFFECTS OF 12-WEEK JOGGING PROGRAMME ON SKILL-RELATED PHYSICAL FITNESS COMPONENTS AMONG SENIOR SECONDARY SCHOOL STUDENTS IN SAFANA LOCAL GOVERNMENT AREA, KATSINA STATE, NIGERIA.

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Abstract

This study investigated the effects of a structured 12-week jogging programme on skill-related physical fitness components (power, agility, and speed) among senior secondary school students in Safana Local Government Area, Katsina State, Nigeria. Using a randomised controlled trial design, 50 participants aged 15-21 years were purposively selected from 569 students across two schools: Community Day Secondary School (experimental group, n=25) and Government Pilot Secondary School (control group, n=25). The experimental group participated in structured jogging while the control group maintained regular activities. Outcome measures included vertical jump test for power, Illinois agility run test for agility, and 30-meter sprint test for speed. Data analysis using ANCOVA at $\alpha = 0.05$ revealed significant improvements favouring the experimental group: power ($F(1,49) = 12.92$, $p = 0.001$, partial $\eta^2 = 0.216$), agility ($F(1,49) = 16.08$, $p < 0.001$, partial $\eta^2 = 0.262$), and speed ($F(1,49) = 50.48$, $p < 0.001$, partial $\eta^2 = 0.528$). Post-test means favoured the experimental group in power (37.92 ± 6.71 vs. 31.36 ± 6.10 cm), agility (17.96 ± 1.25 vs. 18.92 ± 1.72 s), and speed (4.24 ± 0.16 vs. 5.41 ± 0.83 s). The study concludes that structured jogging interventions significantly enhance skill-related physical fitness components in Nigerian secondary school students, with speed demonstrating the most pronounced improvement. The study recommends integrating structured jogging programmes into school curricula, training physical education teachers in programme design and monitoring, and conducting longitudinal research to assess long-term sustainability and academic performance relationships.

Keywords: Jogging, Physical fitness, Skill-related fitness, Secondary school students, Exercise intervention, Nigeria.

Introduction:

Physical fitness is a multidimensional construct encompassing both health- and skill-related components that are fundamental to human performance and well-being (Caspersen et al., 1985). Among adolescents, adequate physical fitness is associated with improved academic performance, enhanced cognitive function, and reduced risk of chronic diseases in adulthood (Donnelly et al., 2016). However, contemporary lifestyle patterns characterised by increased sedentary behaviour and reduced physical activity have contributed to declining fitness levels among school-age populations globally (Guthold et al., 2020).

The World Health Organization (2018) reported that 28% of adults aged ≥ 18 years fail to meet the recommended 150 min of moderate-intensity or 75 min of vigorous-intensity physical activity per week. This trend is particularly concerning among adolescents, with 15.2% of youth demonstrating lower performance-related fitness levels compared to 9.3% of adults (WHO Health Organization, 2019). The implications of poor physical fitness extend beyond individual health outcomes to encompass increased healthcare costs, reduced productivity and elevated all-cause mortality rates (Kassahun, 2018).

Skill-related physical fitness components, including power, agility, speed, balance, coordination, and reaction time, are crucial for sports performance and daily functional activities (Matte, 2015). These components facilitate the acquisition and refinement of motor skills that are essential for athletic excellence and occupational competence. Power, defined as the ability to exert maximum force in the shortest possible time, is fundamental for explosive movements in various sports disciplines. Agility encompasses the capacity to change direction rapidly while maintaining balance and control, and speed represents the ability to move the body or body segments quickly (Zemková & Hamar, 2015).

Research evidence suggests that structured exercise interventions can significantly improve skill-related fitness. Yasumitsu (2014) demonstrated that short-term coordination programs enhanced agility among elementary school students in Tokyo, Japan. Similarly, Jami and Irandoust (2022) reported significant improvements in agility and speed scores following variable exercise protocols compared with constant training regimens. However, limited research has examined the specific effects of jogging programs on skill-related fitness components among Nigerian secondary school students.

Jogging, defined as a form of aerobic exercise involving sustained running at a moderate pace, offers numerous advantages for school-based fitness intervention. It requires minimal equipment, can be performed in various environments, and provides a foundation for developing cardiovascular endurance while simultaneously improving skill-related components (Agus and Sari 2019). The progressive nature of jogging programs allows for gradual adaptation and reduces the risk of injury, making it suitable for adolescent populations (Corbett, 2018).

The Nigerian educational system faces significant challenges in delivering effective physical education programs, with limited resources, inadequate facilities, and insufficient teacher training contributing to suboptimal fitness outcomes among students (Zonal Education Quality Assurance Safana, 2023). This situation necessitates the development and evaluation of cost-effective and scalable interventions that can be implemented within existing educational frameworks.

Skill-Related Physical Fitness Components: Power represents the rate of work performed and is mathematically expressed as the product of force and velocity ($P = F \times V$). In the context of physical fitness, power is typically assessed through explosive movements, such as vertical jumps, standing broad jumps, or medicine ball throws.

Research has consistently demonstrated that power output is influenced by both muscular strength and neural activation patterns, with training adaptations occurring through improved force production and movement velocity (Cormie et al. 2011). Agility encompasses the ability to change direction rapidly while maintaining balance, coordination and speed. It involves complex neuromuscular processes, including perception, decision-making, and motor execution. The Illinois Agility Test employed in this study has been validated as a reliable measure of agility performance, with established normative data for various populations (Getchell, 1979). Agility performance is influenced by factors such as lower extremity strength, balance, and cognitive processing speed. in athletic contexts refers to the ability to move the body or body segments quickly over a given distance. Sprint performance is determined by the stride length, stride frequency, and ability to generate and maintain high running velocities. The 30-meter sprint test provides a valid assessment of acceleration and maximum speed capabilities, with established reliability coefficients exceeding 0.90 in adolescent populations (Durai, 2020).

Jogging interventions have been shown to have significant effects on various fitness parameters. McGraw-Hill Companies (2013) emphasised that jogging programs should be primary objectives in school education and health promotion initiatives. The physiological adaptations to jogging include improved cardiovascular efficiency, enhanced oxidative capacity and increased neuromuscular coordination (Agus & Sari, 2019).

Odo (2020) investigated the effects of brisk walking and jogging on HDL-C levels, concluding that both interventions effectively improved blood lipid profiles, with brisk walking demonstrating superior effects on male HDL-C levels. This study highlights the broader health benefits of rhythmic aerobic activities beyond cardiovascular improvements.

Despite extensive research on aerobic exercise interventions, few studies have specifically examined the effects of jogging programmes on skill-related physical fitness components among Nigerian secondary school students. The unique socio-cultural context, environmental factors, and educational system characteristics in Nigeria necessitate culturally appropriate research to inform evidence-based practices. Furthermore, the majority of existing studies have focused on adult populations or elite athletes, with insufficient attention paid to adolescent school-based interventions.

Methodology

Randomised controlled trial design was used for this research, with pre-test and post-test experimental and control groups. This study was conducted in the Safana Local Government Area, Katsina State, Nigeria, between February and May 2024. The study protocol was approved by the Institutional Review Board of the Federal University Dutsin-Ma, and written informed consent was obtained from all participants and their parents/guardians.

The target population comprised 569 senior secondary school students from Community Day Secondary School (CDSS) and Government Pilot Secondary School (GPSS) in the Safana Local Government Area of the Katsina State. The population distribution included 317 males and 252 females, with ages ranging from to 15-21 years.

The sample size was calculated using G*Power 3.1.9.7 software with the following parameters: effect size (f) = 0.4, $\alpha = 0.05$, power $(1-\beta) = 0.80$, and allocation ratio = 1:1. The calculated minimum sample size was 52 participants, which accounted for potential dropouts.

Participants were randomly allocated to experimental (n=25) and control (n=25) groups using computer-generated random numbers. The experimental group was assigned to CDSS Safana, whereas the control group was assigned to GPSS Safana to minimise contamination between groups. Group allocation was concealed from the outcome assessors to ensure blinding.

The experimental group participated in a structured 12-week jogging program conducted five days per week (Monday to Friday) during scheduled physical education periods. Each session lasted 45 min and included the following:

10-minute warm-up (dynamic stretching), 20-minute moderate-intensity jogging (60-70% HRmax), 10-minute cool-down (static stretching) and 5-minute recovery.

Jogging Programme Description: Development Phase (Weeks 3-6).

During the development phase spanning weeks three to six, participants engaged in a structured training regimen designed to progressively build cardiovascular endurance and jogging capacity. Each session commenced with a comprehensive 10-minute warm-up period to prepare the body for physical activity and reduce injury risk. This was followed by the main training component consisting of 25 minutes of progressive jogging performed at an intensity range of 65-75% of maximum heart rate (HRmax), allowing participants to gradually adapt to increased exercise demands while maintaining aerobic training benefits. Each session concluded with a 10-minute cool-down period to facilitate proper recovery, promote circulation, and prevent muscle stiffness through gradual heart rate reduction.

Maintenance Phase (Weeks 7-12): The maintenance phase, conducted from weeks seven through twelve, represented the peak training period where participants maintained and consolidated their fitness gains achieved during the development phase. Each training session began with a focused 10-minute warm-up to adequately prepare participants for the intensified exercise protocol. The core training component consisted of 30 minutes of sustained jogging performed at a higher intensity range of 70-80% HRmax, reflecting the participants' improved cardiovascular capacity and enabling them to maintain steady-state aerobic exercise for extended periods. The session structure concluded with a

streamlined 5-minute cool-down period, sufficient for participants' enhanced recovery capacity developed through the progressive training adaptation.

Control Group Protocol: The control group maintained their regular daily activities and standard physical education classes throughout the 12-week study period without participating in the structured jogging intervention. This group served as the comparison baseline to isolate the specific effects of the jogging programme on skill-related physical fitness components, ensuring that any observed improvements in the experimental group could be attributed to the structured exercise intervention rather than normal growth, development, or routine school activities. The control group maintained regular school activities, including standard physical education classes, without a structured jogging intervention. They were instructed to continue their normal daily activities and were offered an intervention program upon study completion.

The vertical jump test was used to measure explosive leg power using the following protocol:

Power Assessment - Vertical Jump Test: The vertical jump test was employed to assess lower body power, a critical component of skill-related physical fitness. Participants were positioned with their side adjacent to a wall and instructed to reach upward with their dominant arm to establish their standing reach height, which served as the baseline measurement. Following proper instruction and demonstration, each participant performed a maximal vertical jump utilizing coordinated movements of both arms and legs to achieve maximum height displacement. The vertical jump height was measured at the peak of the jump, and the power score was calculated as the difference between the recorded jump height and the previously established standing reach height. To ensure measurement reliability and account for performance variation, three trials were conducted for each participant with standardized 2-minute rest intervals between attempts to allow for adequate recovery. The highest performance among the three trials was recorded and used for subsequent statistical analysis, ensuring that each participant's optimal power output was captured for the study.

The Illinois Agility Run Test was utilized to measure participants' ability to change direction rapidly while maintaining speed and control, representing a fundamental component of skill-related physical fitness essential for sports performance and daily activities. This standardized assessment protocol requires participants to navigate through a predetermined course involving multiple directional changes, testing their capacity for quick acceleration, deceleration, and lateral movement coordination. The test protocol involved participants lying face-down at the starting line, then sprinting through a course marked by cones that required them to weave between obstacles, make sharp turns, and demonstrate multidirectional movement capabilities. Timing commenced when participants crossed the starting line and concluded upon crossing the finish line, with the total time recorded in seconds. Similar to the power assessment, three trials were conducted with appropriate rest intervals to ensure reliable measurement, and the fastest completion time was recorded for analysis, representing each participant's optimal agility performance.

Secondary Outcomes:

Anthropometric measurements included height (measured using a stadiometer), weight (measured using a digital scale), and body mass index (BMI), which was calculated as weight (kg)/height² (m²). Demographic information was collected using a standardised questionnaire.

Data were collected at three time points: baseline (pre-test), week 6 (mid-test), and week 12 (post-test). All assessments were conducted by trained research assistants blinded to group allocation. Standardised protocols were followed for all measurements, and the environmental conditions were controlled to ensure consistency.

Data were analysed using IBM SPSS Statistics (version 28.0). Descriptive statistics (mean, standard deviation, frequency, and percentage) were calculated for all variables. Normality was assessed using the Shapiro-Wilk test and visual inspection of histograms. Homogeneity of variance was evaluated using Levene's test.

Primary analyses employed Analysis of Covariance (ANCOVA) with pre-test scores as covariates to control for baseline differences. Effect sizes were calculated using partial eta-squared (η^2) with the following interpretations: small (0.01), medium (0.06), and large (0.14). Statistical significance was set at $\alpha = 0.05$, and 95% confidence intervals were calculated for all the estimates.

4. Results

Participant Characteristics:

A total of 50 participants were enrolled and completed the study without any dropouts. Table 1 presents the baseline characteristics of the experimental and control groups.

Table 1: Baseline Characteristics of Study Participants

Variable	Experimental Group (n=25)	Control Group (n=25)	p-value
Weight (kg)	56.3 ± 9.4	57.1 ± 10.2	0.773
BMI (kg/m²)	20.7 ± 2.8	21.1 ± 3.1	0.629
Males, n (%)	13 (52.0)	13 (52.0)	1.000
Females, n (%)	12 (48.0)	12 (48.0)	1.000

No significant differences were observed between the groups at baseline (all $p > 0.05$), indicating successful randomisation.

Table 2: Pre-test and Post-test Vertical Jump Performance

Group	Pre-test (cm)	Post-test (cm)	Mean Difference	95% CI
Experimental	31.24 ± 6.18	37.92 ± 6.71	6.68	4.92 to 8.44
Control	30.86 ± 5.94	31.36 ± 6.10	0.50	-1.26 to 2.26

ANCOVA revealed a significant main effect of group on post-test vertical jump performance ($F(1,47) = 12.92$, $p = 0.001$, partial $\eta^2 = 0.216$). The experimental group demonstrated significantly greater improvements than the control group.

Table 3: Pre-test and Post-test Illinois Agility Run Performance

Group	Pre-test (seconds)	Post-test (seconds)	Mean Difference	95% CI
Experimental	18.84 ± 1.47	17.96 ± 1.25	-0.88	-1.25 to -0.51
Control	19.12 ± 1.68	18.92 ± 1.72	-0.20	-0.57 to 0.17

ANCOVA showed a significant main effect of group on post-test agility performance ($F(1,47) = 16.08$, $p < 0.001$, partial $\eta^2 = 0.262$). The experimental group achieved significantly faster times than the control group.

(30-Meter Sprint Test):

Table 4: Pre-test and Post-test 30-Meter Sprint Performance

	Pre-test (seconds)	Post-test (seconds)	Mean Difference	95% CI
Experimental	4.68 ± 0.34	4.24 ± 0.16	-0.44	-0.58 to -0.30
Control	4.72 ± 0.41	5.41 ± 0.83	0.69	0.55 to 0.83

ANCOVA demonstrated a significant main effect of group on post-test sprint performance ($F(1,47) = 50.48$, $p < 0.001$, partial $\eta = 0.528$). The experimental group showed marked improvement, whereas the control group exhibited performance decrements.

Effect Sizes and Clinical Significance:

All interventions demonstrated large effect sizes according to Cohen's criteria:

- Power: partial $\eta^2 = 0.216$ (large effect)
- Agility: partial $\eta^2 = 0.262$ (large effect)
- Speed: partial $\eta^2 = 0.528$ (large effect)

The magnitude of improvements in the experimental group exceeded the established minimal detectable change values for all measures, indicating clinically meaningful adaptations.

Discussion:

This randomised controlled trial provides robust evidence that a 12-week jogging program significantly improves skill-related physical fitness components among Nigerian secondary school students. The intervention demonstrated large effect sizes across all measured variables, with speed showing the greatest improvement (partial $\eta^2 = 0.528$), followed by agility (partial $\eta^2 = 0.262$) and muscular power (partial $\eta^2 = 0.216$).

The 17.7% improvement in vertical jump performance likely resulted from multiple, concurrent physiological adaptations. Jogging-induced improvements in lower extremity strength, neuromuscular coordination, and stretch-shortening cycle efficiency contribute to enhanced power outputs (Cormie et al., 2011). The progressive nature of the jogging program facilitated gradual adaptation while minimising the risk of injury.

The 4.7% improvement in agility performance can be attributed to enhanced neuromuscular control, improved balance, and increased proprioceptive awareness of the participants. Regular jogging challenges multiple movement planes and requires continuous postural adjustments, contributing to improved change-of-direction capabilities (Zemková & Hamar, 2015).

The substantial 9.4% improvement in sprint performance reflected enhanced running mechanics, increased stride efficiency, and improved neuromuscular activation patterns. Jogging programs develop the aerobic capacity necessary to support high-intensity efforts while simultaneously improving running technique (Yasumitsu 2014).

Our findings align with those of previous investigations examining exercise interventions in school-based settings. Durai and Annes (2019) reported significant improvements in agility and flexibility following a 4-week brisk walking program among college women. Similarly, Muhammad et al. (2020) demonstrated the effectiveness of structured physical fitness programmes in improving multiple fitness components among secondary school students aged 10-15 years.

The magnitude of the improvements observed in our study exceeded those reported in several previous investigations, potentially reflecting the longer intervention duration (12 weeks) and higher training frequency (5 days/week) compared to typical school-based programmes.

These findings support the integration of structured jogging programs into Nigerian secondary school curricula. The cost-effectiveness, minimal equipment requirements, and scalability of jogging interventions make them particularly suitable for resource-limited settings.

The results emphasise the importance of providing physical education teachers with specialised training in exercise program design and implementation. Professional development initiatives focusing on evidence-based fitness interventions may enhance program effectiveness.

The substantial improvements in skill-related fitness components suggest that jogging programs could serve as effective population-level interventions for combating declining physical fitness among adolescents. Implementation strategies should consider cultural preferences, environmental factors, and social determinants of physical activity.

This study has several limitations. First, the study was conducted in a single geographic region, potentially limiting generalisabilities to other populations or settings. Second, the allocation of schools to intervention groups, although practical, may have introduced clustering effects. Third, the study duration (12 weeks) precluded the assessment of the long-term maintenance of fitness improvements. Fourth, the absence of objective physical activity monitoring during non-intervention periods may represent a potential confounding factor.

Conclusions:

This randomised controlled trial provides compelling evidence that a 12-week jogging program significantly improves skill-related physical fitness components among Nigerian secondary school students. The intervention demonstrated large effect sizes across power, agility, and speed measures, with improvements exceeding the clinically meaningful thresholds. These findings support the integration of structured jogging programs into school curricula as an effective strategy for enhancing adolescent physical fitness.

The practical implications extend beyond individual fitness improvements to encompass broader educational and public health concerns. The cost-effectiveness, scalability, and minimal resource requirements of jogging interventions make them particularly suitable for implementation in resource-limited settings. However, successful program implementation requires adequate teacher training, administrative support, and consideration of cultural and environmental factors.

Recommendations:

1. Enhanced Athletic Performance and Physical Capabilities: Regular jogging participation significantly improves explosive power, agility, and speed performance.

2. Improved Cardiovascular Health and Stamina: Structured jogging programmes develop cardiovascular efficiency and aerobic capacity for increased stamina.

3. Enhanced Neuromuscular Coordination and Motor Skills**:** Jogging interventions improve neuromuscular control, balance, and movement coordination.

4. Cost-Effective Health Investment with Long-Term Benefits**:** Participation in jogging programmes requires minimal equipment while delivering substantial health returns.

5. Academic and Cognitive Performance Enhancement**:** Regular physical activity through jogging supports improved cognitive function and enhanced academic performance.

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