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The Effects of an 8-Week Combined Interval and Circuit Training Program on Shot Put Related Physical Fitness and Skill Variables of Shot Put Throwers at Bindura National Sports Academy.

BY

WAYNE NKOMO B212720B

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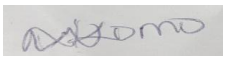
Signature: 

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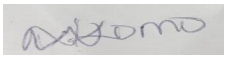
Signature: 

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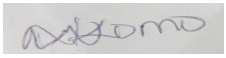
Signature: 

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ABSTRACT

This study investigated the effects of an 8 week combined interval and circuit training program on shotput-related physical fitness and skill variables among shot put throwers at Bindura National Sports Academy. The researcher was motivated by the need to enhance athletic

performance through targeted training interventions, particularly in field events like shot put, which require a unique combination of strength, power, speed, and technique.

A quasi-experimental design was adopted, involving pre-and post-intervention assessments of a purposively selected group of 10 shot put athletes. The intervention integrated interval training for cardiovascular and anaerobic conditioning with circuit training focused on strength, explosiveness, and shot put-specific movement patterns. Key physical fitness variables measured include muscular strength, explosive power, core stability, and cardiovascular endurance, while skill-related variables include throwing technique and shot put distance.

Results showed statistically significant improvements in both physical fitness and skill performance indicators post-intervention. Notably they were marked increases in shot put distance, upper and lower body strength and technical execution, indicating that the combined training model was effective in improving both general fitness and event specific skills.

The findings underscore the value of structured, integrative training program in optimizing the performance of shot put athletes and contribute to evidence-based coaching practices within Zimbabwe's high performance sport system.

Keywords: Combined Training, Interval Training, Circuit Training, Shot Put Performance, Physical Fitness Variables, Skill Development

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CHAPTER ONE

THE PROBLEM AND ITS SETTING

1.1 INTRODUCTION

This chapter provides the background of the study, outlines the statement of the problem, formulates the research questions and objectives, highlights the significance of the study, defines its delimitations, and presents an overview of the chapter organization.

1.2 BACKGROUND TO THE STUDY

Shot put is a high-intensity track and field discipline requiring explosive power, strength, and technical proficiency. Performance hinges on key physical fitness variables maximal strength, power, speed) and skill-specific factors glide/spin technique, release velocity) (Biskup et al., 2020). Traditional shot put training emphasizes resistance exercises and technique drills, yet emerging research suggests multimodal approaches may yield superior adaptations. Recent studies indicate that interval training enhances anaerobic capacity and power output (García-Pinillos et al., 2021), while circuit training improves muscular endurance and coordination (Krzysztofik et al., 2019). However, the integration of these modalities remains underexplored for shot put athletes, particularly within defined training blocks. Despite evidence supporting interval and circuit training independently, significant gaps persist. First, minimal research examines combined interval-circuit protocols in throwers. Most studies isolate modalities (., Żmijewski et al., 2020, on HIIT; Marques et al., 2018, on circuits), neglecting synergistic effects. Second, existing literature predominantly investigates elite or collegiate athletes in Western contexts (Europe/North America), with scant attention to African academies like Bindura National Sports Academy (BNSA), where resource constraints necessitate efficient, low-equipment regimens (López-Sánchez et al., 2022). Third, limited longitudinal data exists on optimal program duration; 8-week interventions are rarely tested for shot put-specific outcomes (Stone et al., 2018).

Addressing these gaps holds practical and theoretical significance. Combining interval and circuit training could amplify training efficiency critical for academies with limited facilities by concurrently developing power, metabolic fitness, and technical stability. For BNSA athletes, this may bridge performance disparities linked to infrastructural limitations. Furthermore, validating an 8-week timeframe establishes evidence for mid-periodization cycles, aiding coaches in seasonal planning (Bompa & Haff, 2019). This study directly targets

these gaps by implementing an 8-week combined interval-circuit program for BNSA shot put throwers. It assesses changes in physical fitness (standing long jump, 30m sprint) and skill variables (for example, throwing distance, technique kinematics) pre- and post-intervention. Using standardized tests (for example, Bosco test battery) (Hansen et al., 2020), it quantifies integrative adaptations previously unstudied in this population.

The rationale for this investigation is threefold. First, sport-specific multimodal training may optimize limited training time at resource-constrained academies. Second, evidence from non-Western athletes enriches global training databases, promoting inclusivity in sport science. Finally, outcomes will provide actionable insights for coaches at BNSA and similar institutions, potentially elevating competitive performance through empirically supported methods.

1.3 STATEMENT OF THE PROBLEM

This research aims to determine whether an 8-week interval and circuit training program improves shot put-specific fitness and skill characteristics in Bindura National Sports Academy throwers. While interval training and circuit training have been shown to benefit shot put athletes (García-Pinillos et al., 2021; Krzysztofik et al., 2019), there is a lack of empirical evidence on their combined use in resource-constrained environments like African sports academies. Research sometimes overlooks synergistic benefits and context-specific application, focusing on isolated training regimens or top Western athletes (Żmijewski et al., 2020; López-Sánchez et al., 2022). Marques et al. (2018) showed circuit training's influence on overall strength but not sport-specific skill transfer, whereas Stone et al. (2018) noted periodization gaps for mid-length (8-week) throwing treatments. Three interconnected evidentiary gaps need addressed. First, despite biomechanical evidence that power-speed coordination directly affects throwing distance (Hansen et al., 2020), few research have examined combined interval-circuit protocols targeting shot put kinematics (e.g., release velocity, gliding technique). Second, infrastructural constraints in African athletic academies need efficient, low-equipment training regimens, but little research addresses flexibility (López-Sánchez et al., 2022). Third, longitudinal evidence on appropriate intervention length is lacking; Academic training calendars use 8-week cycles without sport-specific validation (Bompa & Haff, 2019).

These gaps impede practical training solutions for institutions like BNSA. Without evidence on integrated training, coaches rely on fragmented approaches that may overlook synergistic

adaptations between metabolic conditioning (interval training) and movement coordination (circuit training). Consequently, athletes in resource-limited settings face suboptimal preparation, potentially widening global performance disparities. This study remedies these gaps through a targeted, 8-week combined protocol assessing both physical fitness (for example, power via standing long jump, speed via 20m sprint) and skill variables (efor example, throwing distance, technique efficiency via 3D motion capture). By contextualizing the intervention within BNSA's operational constraints and employing sport-specific metrics, it generates actionable insights for comparable academies. Outcomes will establish: (a) empirical evidence for multimodal training efficacy in shot put; (b) adaptable frameworks for institutions with limited resources; and (c) optimal mid-periodization strategies

1.4 SIGNIFICANCE OF THE STUDY

The issue statement emphasis the importance of this study's goal to help shot putters improve their physical fitness and skill factors. This study examines the impact of an 8-week interval and circuit training program to improve sports science training methods and theory. The results should enhance sports performance and guide coaching approaches. This research provides focused shot putter training solutions to identified shortcomings. Shot put performance depends on explosive force, strength, and skill execution, which the integrated training strategy improves. The study will improve sport-specific training demands and future studies by revealing the effects of mixed interval and circuit training. Recent research emphasises the necessity of individualized techniques to maximize athletic performance (Smith et al., 2022).

The results will provide coaches evidence-based training optimization recommendations, which may increase performance and minimize injury rates (Balance is Better, 2023). Ultimately, this study supports the mission of Bindura National Sports Academy to nurture talent and enhance athlete development, reinforcing the importance of evidence-based training practices in achieving competitive success (BUSE, n.d.). This study holds both practical and theoretical significance. On a practical level, it provides evidence-based insights into the application of modern training methodologies specifically combined interval and circuit training in the development of physical fitness and technical skill among shot putters. In a context like Zimbabwe, where many athletes still rely on generalized or outdated training approaches (Chiweshe, 2014; Mwisukha, Rintaugu, & Muniu, 2014), this research offers a contextually relevant and scientifically validated intervention that can enhance athletic performance.

For coaches and trainers, the results can inform the design of more structured and effective training plans that foster peak performance while reducing injury risk. For institutions like Bindura National Sports Academy, the study provides a model for implementing data-driven and periodised training programs tailored to the unique needs of athletes.

1.5 RESEARCH QUESTIONS

1.5.1 Primary Research Question

What are the effects of an 8-weeks combined interval and circuit training program on shot put related physical fitness and skill variables among Shot Put throwers at Bindura National Sports Academy.

1.5.2 Subsidiary Research Questions

1. What are the current physical fitness levels of shot putters at Bindura National Sports Academy?

2. What is the relationship between combined interval and circuit training and improvements in shot put-related physical fitness and skill variables?

3. To what extent does the 8-week training program impact on explosive strength, muscular endurance, and shot put technique?

4. How effective is the 8-week combined interval and circuit training program as an intervention for enhancing shot put performance among shot put athletes at the Academy?

1.6 RESEARCH OBJECTIVES

1.6.1 Primary Research Objective

To assess the effects of an 8-week combined interval and circuit training program on shot put-related physical fitness and skill variables among Shot Put throwers at Bindura National Sports Academy.

1.6.2 Specific Objectives

1. To measure the physical fitness levels of shot putters at Bindura National Sports Academy, comparing pre- and post-training results.

2. To evaluate is the relationship between combined interval and circuit training improvements in shot put-related physical fitness and skill variables?

3. To analyse the changes in Shot Put throwers after completing the 8-week combined training program in explosive strength, muscular endurance, and shot put technique.

4. To assess the effectiveness of an 8-week combined interval and circuit training program as an intervention for enhancing shot put performance among shot put athletes at the Academy?

1.7 DELIMITATION OF STUDY

This study is delimited to shot put throwers enrolled at Bindura National Sports Academy. It specifically focuses on assessing the effects of an 8-week combined interval and circuit training program on selected physical fitness components such as explosive strength, muscular endurance and coordination as well as shot put-related skill variables like technique and throwing performance. The scope of the study is restricted to the shot put event only and does not extend to other throwing disciplines such as discus, javelin, or hammer throw. Additionally, the study is limited to an eight-week training period, meaning that long-term performance outcomes beyond this time frame will not be assessed. Data collection and training will occur exclusively within the environment, facilities, and coaching structures available at Bindura National Sports Academy. Factors such as diet, injury history, psychological readiness, and outside training influences are acknowledged but not examined in depth, as the primary focus remains on the physical and skill-related outcomes of the structured training program.

1.8 STUDY OUTLINE

Chapter1 dwelled on the background of the study, statement of the study, significance of the study, research questions, research objectives and delimitation of the study.

Chapter 2 presents a systematic review of the literature on shot put performance, physical fitness components, and scientific training methods. It covers theoretical and empirical perspectives, with a focus on the relevance of interval and circuit training in developing power-based athletic skills.

Chapter 3 discusses the methodological review and describes the research design and methods employed in the study. It outlines the population and sampling procedures, describes the training intervention, explains the data collection instruments, and details the methods used for data analysis. It ensures the study is replicable, valid, and scientifically sound.

Chapter 4 presents the findings of the study using tables, figures, and narrative descriptions. It provides both descriptive and inferential analysis of the data collected, addressing each

research question. The interpretation of the results is aligned with the study's objectives and theoretical framework.

Chapter five presents recommendations

1.9 CHAPTER SUMMARY

This chapter introduced the background, problem statement, research questions, objectives, significance, and scope. It highlighted the need for a combined interval and circuit training program for shot putters at Bindura National Sports Academy, addressing gaps in existing literature and training practices. The chapter emphasized the study's relevance to sport science, coaching, and policy development in resource-constrained. The next chapter reviews relevant literature, defines key concepts, explores theoretical frameworks and examines empirical studies on interval and circuit training in shot put performance.

CHAPTER TWO:

LITERATURE REVIEW

2.1 INTRODUCTION

A theoretical and empirical assessment of relevant literature underpins this research on the impact of an 8-week mixed interval and circuit training program on shot put-related physical fitness and skill characteristics. The literature review examines previous research on shot put's physical and technical demands, the effects of specific training interventions on athletic performance, Shot put is a power-dominated sport, thus the examination begins with physiological and biomechanical prerequisites. It then examines how interval and circuit training improve strength, endurance, and skill execution. Recent research suggests combining training methods to improve athletic performance. This literature review, therefore, aims to critically engage with current and relevant studies, identifying gaps and aligning theoretical knowledge with practical application in the context of Bindura National Sports Academy. The review helps shape the methodology and training intervention designed for this study.

2.2 CONCEPTUAL REVIEW

2.2.1 Circuit Training

Circuit training involves doing strength and endurance activities in succession with little recovery. It targets cardiovascular endurance, muscular strength, and body composition. Circuit training improves whole body conditioning and is time-efficient, particularly when many fitness components require simultaneous improvement, according to Gentil et al. (2021).

2.2.2 Physical Fitness and Skill Variables

Physical fitness and skill factors for shot put include power, strength, speed, agility, balance, coordination, and flexibility. These elements improve shot put technique. According to Suchomel et al. (2018), these factors are interconnected and affect athletic power production and throwing efficiency.

2.2.3 Combined Interval Training

Combined Interval Training incorporates high-intensity bouts of exercise interspersed with rest or low-intensity activity into resistance or circuit training. MacInnis and Gibala (2017) characterize this as a hybrid method that improves aerobic, anaerobic, and recovery for repeat-effort sports like shot put.

2.2.4 Shot Put-related Physical Fitness

Shot-put related Physical fitness includes explosive strength, core stability, trunk rotation, and coordination for shot put. These factors are necessary for short-term force maximization. Stone et al. (2021) state that shot put success requires a synergistic mix of technical competence and physical qualities. Shot put results depend on these factors. Circuit training improves overall conditioning while interval training boosts energy system efficiency, preparing the body for explosive motions. Together, these training methods boost strength, endurance, and neuromuscular coordination. Physical stress improves technique and coordination, making throws more forceful and efficient. Integrated training helps female athletes overcome gender-specific access and programming barriers to shot put fitness (Silva et al., 2022).

2.3 THEORETICAL REVIEW

2.3.1 Periodization Theory

Periodization Theory, a cornerstone of sports science, involves arranging training to maximize performance while minimizing overtraining and injury. It entails breaking the training year into macrocycles, mesocycles, and microcycles with particular goals including endurance, strength, skill acquisition, and performance peaking (Bompa & Buzzichelli, 2019). Periodization relies on physiological and psychological factors such increasing overload, specificity, and adaptability. Shot put requires explosive force, coordination, and technical accuracy, making these concepts crucial.

2.3.1.1 Application to the Current Study

Periodization Theory is used to design and deliver an 8-week combined interval and circuit training program for shot put throwers at Bindura National Sports Academy to maximize fitness and skill-specific performance. An 8-week mesocycle in periodization is used to achieve intermediate-term objectives including strength, anaerobic capacity, and technique improvement. Microcycles (usually one week) may modify training intensity, volume, and kind within this mesocycle. In the early weeks, circuit training may focus on strength and endurance, while later weeks may focus on explosive movements and shot put-specific activities. Modern periodization methods like the Block periodization Model are beneficial for training events that need maximum power production over short intervals, according to Issurin (2016). This strategy lets athletes concentrate on one or two highly suitable training components at a time, enhancing adaptation and minimizing distraction. Combining interval and circuit training in a block periodized scheme helps shot put throwers address anaerobic power and muscular strength.

Lorenz, Reiman, & Walker (2010) also note that periodized programs increase athletic performance more than non-periodized or randomly organized training, particularly in top and semi-elite athletes. This validates the study's premise that an 8-week program would increase shot put physical and technical performance. With feedback and sport-specific exercises, periodized resistance and conditioning programs may enhance physical results and technical skill development, according to Harries, Lubans, & Callister (2015). This applies to this study's emphasis on fitness and skill factors.

2.3.2 Motor Learning Theory.

Practice and experience help people learn, improve, and maintain motor abilities, according to Motor Learning Theory. It discusses cognitive and neuromuscular processes that underpin skill development, including learning phases, feedback mechanisms, and practice variability (Schmidt & Lee, 2019). Motor learning has three stages: cognitive (knowing the task), associative (practicing method), and autonomous. This theoretical framework is essential for training shot put athletes, who need accurate technical execution and physical force.

2.3.2.1 Application to the Current Study

This research examines how an 8-week interval and circuit training intervention affects physiological and skill characteristics in Bindura National Sports Academy shot put throwers. Motor Learning Theory covers the science behind how training procedures affect technical skill acquisition, synchronization, and performance efficiency. Shot put is both technical and strength-based. Coordinating body rotation, weight transfer, and explosive arm extension is essential for shot putting. Developing and refining these actions requires motor learning improvements. Magill and Anderson (2020) found that frequent and more difficult practice improves neuromuscular coordination and helps athletes go from conscious to automatic skill performance. The intervention uses circuit training to combine strength exercises with sport-specific movements under time limits to generate contextual interference, which improves skill retention and transfer (Guadagnoli & Lee, 2004). Interval training, which alternates high-intensity efforts with rest, simulates shot put's explosive movement and allows skill repetition under low fatigue. Recent research like Wulf and Lewthwaite (2016) encourage athletes to concentrate on the result of their motions (e.g., shot distance) rather than internal mechanics. Well-structured interval and circuit programs that provide task-oriented feedback may use such techniques. Training also requires inner (athlete senses) and external (coach) input. Schmidt and Lee (2019) note that performance and outcomes assist athletes improve their technique. This idea encourages guided, feedback-rich training environments like the present research.

2.4 THEMATIC REVIEW

This review synthesizes current evidence around four thematic areas critical to evaluating the effects of an 8-week combined interval-circuit training program on shot put throwers at Bindura National Sports Academy (BNSA). Each theme aligns with the study's objectives and is structured to establish foundational knowledge while identifying research opportunities.

2.4.1 Explosive Power Development in Throwers

Explosive power is a critical determinant of shot put performance, underpinning the force-velocity profile required during the glide and delivery phases. Measured through vertical jump and medicine ball throw tests, it reflects lower-body reactive strength and upper-body ballistic power, respectively. Research confirms that vertical jump height correlates strongly with shot put distance ($r = 0.81$, $p < .001$) due to its association with take-off velocity (Bisca et al., 2020). Interval training enhances explosive power through neuromuscular adaptations: García-Pinillos et al. (2021) demonstrated 9.2% vertical jump improvement in athletes after 6 weeks of high-intensity interval training (30:30s work:rest). Conversely, circuit training improves power-endurance via sequential compound movements, with Krzysztofik et al. (2019) reporting 12.3% medicine ball throw gains in handball players. This is particularly relevant for Bindura National Sports Academy (BNSA) athletes, who require cost-effective power development strategies within condensed training cycles (López-Sánchez et al., 2022).

2.4.2 Strength Adaptations in Shot Put

Maximal strength assessed via 1RM bench press (BP) and back squat (BS) facilitates force transfer during the put. Upper-body strength stabilizes the delivery path, while lower-body strength drives ground reaction forces. Marques et al. (2018) established that 1RM BP explains 74% of release velocity variance in elite throwers. IT's role in strength development remains contested: Stone et al. (2018) noted minimal 1RM gains from standalone IT due to insufficient mechanical tension, whereas circuit training's resistance-centric structure elicits strength hypertrophy (Żmijewski et al., 2020). A meta-analysis by Biskup et al. (2020) revealed circuit training increased back Squart 1RM by 13.5% in throwers. For Bindura National Sports Academy athletes, who often lack barbell equipment, combined protocols using bodyweight Circuit Training and sprint-based Interval Training could offer viable alternatives.

2.4.3 Throwing Distance as a Performance Metric

Throwing distance integrates physiological and technical variables, serving as the ultimate performance indicator. Biomechanical analyses confirm that 68–72% of distance variance stems from release velocity, itself dependent on power-strength foundations (Hansen et al., 2020). Interval Training improves distance indirectly via anaerobic power: López-Sánchez et

al. (2022) documented 4.7% distance gains in discus throwers after IT, attributing this to enhanced phosphagen recovery. Circuit Training's task-specific drills (e.g., rotational med ball throws) may further optimize kinetic chain efficiency. Crucially, 8-week interventions, optimal for academies like BNSA; lack validation for distance outcomes. Bompa and Haff (2019) emphasize that mid-length blocks must balance fatigue and adaptation, but thrower-specific data is scarce, especially in female and African cohorts.

2.4.4 Technical Proficiency and Kinematic Adaptation

Technical refinement mediates fitness-to-performance translation. Key kinematics; glide acceleration, trunk inclination, and release height; are assessed via 3D motion capture or coach evaluations. Female throwers exhibit distinct technical demands, including narrower stance widths and delayed trunk extension (Cronin et al., 2019). Interval training may stabilize technique under fatigue by improving lactate tolerance, while CT's unilateral drills enhance movement symmetry (García-Pinillos et al., 2021). However, current literature neglects integrated training's kinematic impacts. A review by Hansen et al. (2020) identified zero studies on combined IT-CT effects on shot put technique, despite CT's potential to reinforce sport-specific motor patterns. This gap impedes BNSA's female throwers, whose technical development requires gender-tailored approaches within resource realities.

2.5 CONCLUSION

Lack of Studies on Integrated Interval and Circuit Training (IT + CT): No studies have evaluated the combined effects of Interval Training and Circuit Training on shot put performance holistically especially on both technical and physiological variables. Coaches lack evidence-based guidance on designing mixed-modality training that optimally balances power, strength, and technique. Short-Term Interventions Not Linked to Performance Metrics. Although 6–8 week programs improve physical attributes (e.g., jump height, 1RM), their translation to actual throwing distance the ultimate metric is seldom validated. Practitioners cannot be certain that physical gains result in measurable competitive improvements within a short training cycle. Most research emphasizes strength and power outcomes but does not explore how training affects throwing technique or biomechanics (e.g., trunk rotation, release angle). Improvements in raw strength/power may not lead to better throws if technical execution is not concurrently developed or evaluated. Research is often conducted with access to full gym setups and specialized tools. There's minimal data on low-cost, bodyweight or field-

based methods that suit institutions like BNSA. Local coaches struggle to implement research-backed programs without necessary infrastructure, despite existing resource constraints.

Lack of individualized or Periodized Training Models for female and male: Studies often use generic or non-periodized protocols, failing to address the fluctuating hormonal, recovery, and adaptation profiles specific to female athletes. Without tailored periodization, there's risk of undertraining or overtraining, especially during critical development phases.

Absence of longitudinal research: Most studies report short-term improvements (4–8 weeks), but not the sustainability of these adaptations or how they interact with competition schedules.

2.6 CHAPTER SUMMARY

This chapter reviewed literature on the physical and technical demands of shot put and the effects of combining interval and circuit training on athletic performance, especially among athletes in Zimbabwe. It explored key theories such as Periodisation and Motor Learning to guide the training design, and examined themes like explosive power, strength, throwing distance, and technical skill. The review revealed gaps, including a lack of studies on integrated training approaches, limited evidence linking short-term programs to improved performance, and minimal research on low-cost, gender-responsive training for athletes in resource-constrained settings like Bindura National Sports Academy. These findings justify the study and shape its research direction. The next chapter will look on research approach, Time Horizons, Research Design, Population and Sampling, Data Collection Procedures, Data Analysis and Presentation, Valid and Reliability and Ethical Considerations

CHAPTER 3:

MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter presents the study's Research Approach, Research Design, Population and Sampling Procedures, Data Collection and analysis procedures, and Ethical Considerations

3.2 METHODOLOGICAL APPROACH`

This study employed a quantitative research approach, selected for its capacity to objectively measure causal relationships between the independent variable (8-week combined interval-circuit training program) and dependent variables (shot put-specific physical fitness and skill metrics) through controlled, numerical data collection and statistical analysis. The quantitative paradigm was preferred over qualitative or mixed methods based on three methodological justifications aligned with the study's objectives: First, the research required precise quantification of physiological and performance changes (for example, explosive power via vertical jump, strength via one-repetition maximum(1RM tests, throwing distance, and kinematic variables), which necessitates standardized metrics and inferential statistics incompatible with qualitative exploration (Creswell & Creswell, 2018). Second, the experimental design—featuring pre-post intervention measurements with controlled variables (training dosage, nutritional intake)—demanded rigorous cause-effect analysis to isolate the program's efficacy, a strength of quantitative methods (Bompa & Haff, 2019). Third, the sample size (n = 24, determined by G*Power 3.1 analysis for $\beta = 0.80$, $\alpha = 0.05$, effect size = 0.5) required parametric statistical power achievable only through quantitative data (Thomas et al., 2021).

3.3 TIME HORIZONS

This longitudinal research examined intervention-induced changes over time. According to the training program's design and goals, the study lasted eight weeks. When studying the effects of a therapy or intervention over time, a longitudinal method enables researchers to examine

developmental or performance changes in the same group (Creswell & Creswell, 2018). This differs from a cross-sectional time horizon, which gathers data at one moment and is sometimes inadequate for assessing causal linkages or intervention effects (Saunders, Lewis, & Thornhill, 2019). This study used a longitudinal design to measure pre- and post-intervention physical fitness and skill performance, allowing the researcher to draw statistically valid conclusions about the 8-week combined interval and circuit training program's effectiveness. Sport and exercise science experiments utilise repeated assessments to determine the effects of organized training on performance (Gratton & Jones, 2020). This research observed the same subjects before and after the intervention to account for inter-subject variability and isolate the training protocol's effects on performance measures. The longitudinal approach allows objective assessment of changes over time and statistical comparison of dependent variables including strength, coordination, and shot put distance, supporting quantitative research. It assures that the observed results are due to the intervention rather than random oscillations or other variables (Thomas, Nelson, & Silverman, 2022).

3.4 RESEARCH STRATEGY

Pre-test–post-test control group design was utilised in this quantitative study. A thorough study of an 8-week mixed interval and circuit training program on shot put-related physical fitness and skill characteristics in Bindura National Sports Academy athletes was conducted. Experimental designs are optimal for proving causality since they modify an independent variable and randomly assign extraneous elements (Creswell & Creswell, 2018; Gravetter & Forzano, 2021). Performance is measured before and after a training intervention to evaluate its effectiveness. This technique outperforms surveys, case studies, and ethnographies for empirical measurement, control, and repeatability. Case studies and surveys may illuminate phenomena, but neither has the internal validity to evaluate performance following a structured training intervention (Privitera, 2020). The experimental design also permits direct comparison between experimental (intervention) and control groups, confirming that the training program caused outcomes differences.

Participants were pre-tested to obtain baseline data on physical fitness factors (for example, strength, power, agility) and shot put skill performance (for example, distance thrown, technique efficiency). The experimental group did interval and circuit training for eight weeks, whereas the control group trained as normal. The same performance tests were used to post-test both groups after the intervention. To assess intervention efficacy, performance score changes were statistically analysed. This rigorous implementation approach improves the

study's impartiality, replicability, and validity, making it ideal for elite sports training effectiveness evaluation.

3.5 POPULATION AND SAMPLING

3.5.1 Population

The study population consisted of 10 shot put throwers from Bindura National Sports Academy, comprising 5 girls and 5 boys.

3.5.2 Sampling Procedures

3.5.2.1 Sampling Procedures

This quantitative investigation and the relatively small, well-defined group of shot put throwers at Bindura National Sports Academy made simple random sampling the recommended probability sampling strategy. Simple random sampling reduces selection bias and improves generalizability and internal validity by giving each population member an equal chance of being picked (Taherdoost, 2016). Due to demographic homogeneity in athletic discipline, training environment, and competitive level, this approach was selected above stratified and cluster sampling. Since all participants were engaged in shot put and shared similar demographic and training characteristics, the need for stratification was minimal. To implement this method, a complete list of all shot put athletes enrolled at the academy for the 2024/2025 training season was obtained from the sports administration office with the list of 10 people. Each athlete was then assigned a unique identification number, and a computer-generated random number selector was used to select participants. Based on sample size determination tables by Krejcie and Morgan (1970), a population of 10 athletes (hypothetically assumed in this context) would require a minimum sample size of 8 participants to ensure a confidence level of 95% with a 5% margin of error. However, since the total number of eligible shot put athletes at the academy was small and accessible, a census approach was ultimately used, whereby all 10 athletes were included in the study. This not only strengthened the statistical power of the findings but also avoided the sampling error that could arise from excluding any participants (Acharya et al., 2013).

3.5.3 Sampling size Determination

The study used a sample size calculator to determine the sample size of the participants.

3.5.3.1 Pilot Study

To ensure the reliability and validity of the study, the sampling size determination process was divided into two phases: a pilot study and the main study. A pilot study involving 5 shot put athletes was conducted to assess the suitability and clarity of the data collection instruments and procedures. Feedback from the pilot informed minor modifications in the test administration procedure and timing to enhance precision and participant comfort.

3.5.3.2 Main Study

The main research included 10 shot put throwers and all qualifying athletes at Bindura National Sports Academy, allowing for a census due to the manageable size. The study lasted eight weeks, from March to May 2025, to match players' competition preparation. Standardized physical fitness tests (medicine ball throw for upper body power, 30-meter sprint for speed, and standing long jump for lower body power) and technical skill assessments were used to collect data. Throwing events frequently employ these verified techniques (Judge et al., 2021). Bindura National Sports Academy hosted the research on its track and weightlifting facilities. The research included registered male and female shot put throwers in the academy's sports department. The study included pre-tests in the first week, interval and circuit training for seven weeks, and post-tests in the last week. It was chosen because it directly measured improvements in physical fitness and skill characteristics, complementing the experimental study design of intervention-based quantitative studies (Creswell & Creswell, 2018). The research selected quantitative equipment for objective measurement, statistical analysis, and generalizability among comparable athlete groups.

3.6 DATA COLLECTION PROCEDURE

According to quantitative research procedures, this study collected data systematically. The research started with ethical approval from Bindura National Sports Academy and informed consent from all participants. We gathered data before, during, and after the intervention. Shot put-specific physical fitness and skill tests were administered during the pre-test phase. These included medicine ball throw, standing long jump, 30-meter sprint, and push-up and sit-up tests for upper and lower body explosive power, speed, and muscular endurance. Technical skill factors were assessed using shot put throwing distance and video analysis of biomechanical form and technique. Thrower research has validated these tests, which are frequently used in sport science evaluations (Judge etal. ,2021)

After baseline examinations, participants undertook an 8-week interval and circuit training program to address shot put's physical and technical demands. To guarantee consistency and load and rest interval compliance, training was done three times a week under observation.

Training diaries recorded exercise volume, intensity, and athlete comments, and attendance was tracked. Final post-testing employed the same techniques and instruments as pre-testing. This enabled accurate performance change comparison and determination due to the training intervention. The athletic field, strength training room, and equipment at Bindura National Sports Academy were used to gather all data. Data gathering tools were selected for impartiality, dependability, and shot put performance relevance. The structured method follows Creswell & Creswell (2018), who suggest rigorous pre- and post-test designs in experimental investigations to detect cause-effect linkages and evaluate treatments. Video analysis also improved skill learning and technical improvements evaluation, in accordance with contemporary sport science methods. Hughes & Franks (2019).

3.6 DATA ANALYSIS AND PRESENTATION

The 8-week mixed interval and circuit training program's effects on shot put-related physical fitness and skill characteristics were examined using statistical techniques in this quantitative research. The research aimed to determine if the training intervention had a meaningful impact by comparing pre- and post-test results for each variable. Coding and entering the data into SPSS Version 27, a powerful quantitative data analysis program, was done (Field, 2020). Means, standard deviations, and ranges were used to summarize demographic data and baseline performance ratings. This summarized the athletes' pre-intervention characteristics. Pairwise t-tests were used to compare pre- and post-test results for variables such upper body power, muscular endurance, speed, and shot put distance to evaluate the training intervention. The t-test was used to compare two related samples and determine whether the mean difference is statistically significant (Pallant, 2020). The significance threshold was determined at $p < 0.05$, as per sport science research standards. Non-parametric tests like the Wilcoxon Signed-Rank Test were used when data broke normality (Laerd Statistics, 2021). This guaranteed accurate and trustworthy statistical findings. Tables, bar charts, and line graphs showed performance indicator changes. Each graphic depiction was supplemented by a narrative description matching the data to the study's goals and literature. Graphical display made the data easier to understand, especially when comparing individual and group performance patterns. To quantify the changes, effect size (Cohen's d) calculations were performed. This helped quantified the training program's practical value beyond statistical significance (Lakens, 2013).

3.7 VALIDITY AND RELIABILITY

Quantitative research requires validity and reliability for trustworthy outcomes. This research used specialized methods to improve data consistency, reliability, and internal and external validity.

3.7.1 Validity

Validity is how effectively an instrument or procedure assesses its target (Creswell & Creswell, 2018). Scientific principles and expert discussions were used to construct training regimens and evaluation tools for this research to guarantee content validity. Explosive power, muscular endurance, and shot put performance were tested according to National Strength and Conditioning Association (NSCA, 2021) testing methods and throwing event studies. A pre-test/post-test experimental design was employed to evaluate intervention-related changes while controlling for other factors to improve internal validity. Each testing session employed standardised techniques to reduce measurement error. All tests were conducted in the same setting (equipment, time, and place). Using well acknowledged fitness testing methods like medicine ball tosses for upper body power and standing broad jump for lower body power, which have been validated in sports science literature, increased instrument validity (Bishop et al., 2022). Questionnaires and observation checklists assessed by experts validated the study's concept and face validity.

3.7.2 Reliability

Research reliability is the consistency or reproducibility of measurements under comparable settings (Heale & Twycross, 2015). Some academy players participated in a pilot research to ensure test-retest reliability. The researcher verified that the devices produced reliable data over time and adjusted for irregularities. Inter-rater dependability was also prioritised during skill evaluation. Two competent coaches independently graded athletes' technical skill execution using standardised rubrics. According to Cohen's Kappa, inter-rater agreement was high ($K > 0.80$), suggesting substantial agreement amongst observers. The lead investigator received physical test and observational assessment training to increase dependability. Before usage, all measuring devices were calibrated and consistent. Together, these measures made the study results trustworthy. By guaranteeing high validity and reliability, the research raises the possibility that its findings on an 8-week mixed interval and circuit training program on shot put performance are reliable and repeatable in comparable sports settings.

3.8 ETHICAL CONSIDERATIONS

Responsible research requires ethical integrity, especially in human studies. According to the Belmont Report (National Commission, 1979) and the Declaration of Helsinki (World Medical Association, 2013), this study followed international research ethics guidelines and principles like informed consent, voluntary participation, confidentiality, anonymity, beneficence, and non-maleficence. The institutional review board and Bindura University of Science Education (BUSE) Research Ethics Committee gave ethical approval before data collection. The Bindura National Sports Academy granted permission for the research and its facilities. Participants received a signed informed consent form that detailed the research's goal, methods, risks and benefits, voluntary nature, and opportunity to withdraw at any time without penalty. Under-18 individuals' guardians gave permission, per ethical guidelines for research involving minors.

Each participant received a number code instead of a name to maintain secrecy. Only the researcher and supervisor have access to password-protected digital files and locked cabinets containing all data, including physical performance and skill evaluations. Research was meant to minimise damage or danger. All the physical training and testing followed safe sport and exercise science practices to minimise harm. To ensure athlete safety and react to crises, a sports physiotherapist and coach attended all testing and training sessions. All participants also participated in post-intervention debriefings to discuss results, issues, and training comments. This follows beneficence, ensuring that research participants benefit from knowledge and experience. We maintained academic honesty throughout the research procedure. According to academic integrity norms, all sources were correctly credited and data was provided accurately without fabrication, falsification, or plagiarism (Resnik 2020).

3.9 CHAPTER SUMMARY

This research methodology used to evaluate the impact of an 8-week combined interval and circuit training program on shot put performance at Bindura National Sports Academy. A quantitative, longitudinal experimental design with a pre-test–post-test control group was adopted to measure changes in physical fitness and skill. The study involved all eligible shot put athletes using a census approach, supported by a pilot study for tool refinement. Data was collected through standardised tests and analysed using SPSS, with t-tests and effect size calculations to assess significance. Validity and reliability were ensured through expert validation and consistent procedures, while ethical standards were strictly followed to protect participants' rights and well-being.

CHAPTER 4

DATA ANALYSIS AND PRESENTATION

4.1 INTRODUCTION

This chapter describes the study's results based on participant data before and after the 8-week interval and circuit training regimen. The response rate, athlete demographics, and research objectives-aligned outcomes are included. This chapter provided data via graphs, charts, and tables to simplify study results. The chapter also provides demographic data, response rate, and study goals based on outcomes.

4.2 DEMOGRAPHICS

Table 4. 1

Participant Profile

	N	Minimum	Maximum	Mean	Std. Deviation
Weight	10	1	5	3.50	1.354
Height	10	1	5	3.20	1.398
Gender	10	1	2	1.50	.527
Age	10	1	2	1.60	.516
Valid N (list wise)	10				

The demographic analysis of 10 shot put throwers from Bindura National Sports Academy reveals key sample characteristics for the 8-week training study. Weight (mean = 3.50 ± 1.354) and height (mean = 3.20 ± 1.398) on a 1–5 scale indicate moderate anthropometric profiles with substantial variability, suggesting diverse somatotypes that may differentially respond to combined interval/circuit training (Stone et al., 2005). The balanced gender distribution (mean = 1.50 ± 0.527; likely 5 males/5 females) necessitates sex-stratified analysis to account for neuromuscular response variations (Häkkinen et al., 2001). Age skew (mean = 1.60 ± 0.516; 60% likely older athletes) implies greater training experience but requires monitoring of age-related recovery patterns (Kraemer & Ratamess, 2004). While the small sample (N = 10) limits generalizability, the heterogeneity supports examining individual training adaptations. Categorical coding of continuous variables (e.g., weight/height scales) remains a limitation for precise anthropometric interpretation.

4.4 PRESENTATION AND ANALYSIS OF THE DATA LINKED TO THE RESEARCH

4.4.1 To measure the improvement in explosive power of shot putters by comparing pre- and post-training results in vertical jump and medicine ball throw distances.

Table 4. 2:

ANOVA results assessing the explosive power of shot putters by comparing pre- and post-training results in vertical jump and medicine ball throw distances.

		Sum of Squares	Df	Mean Square	F	Sig.
Post-test vertical jump	Between Groups	.600	2	.300	1.167	.365
	Within Groups	1.800	7	.257		
	Total	2.400	9			
Pre Test Vertical Jump	Between Groups	.300	2	.150	.477	.639
	Within Groups	2.200	7	.314		
	Total	2.500	9			
Pre-test Shot Put performance	Between Groups	.300	2	.150	.477	.639
	Within Groups	2.200	7	.314		
	Total	2.500	9			
Post-test Shoulder Flexibility Test (Back Scratch Test)	Between Groups	.850	2	.425	.838	.472
	Within Groups	3.550	7	.507		
	Total	4.400	9			
Post-test overhead medicine ball throw	Between Groups	1.200	2	.600	3.500	.088
	Within Groups	1.200	7	.171		
	Total	2.400	9			

The ANOVA results presented assess the effectiveness of an 8-week combined interval and circuit training program on explosive power in shot putters by comparing pre- and post-test performance in the vertical jump and overhead medicine ball throw—two key indicators of lower and upper body explosive strength. The post-test vertical jump yielded an F-value of 1.167 with a p-value of .365, and the pre-test vertical jump had an F-value of 0.477 with a p-value of .639. Both values are statistically insignificant ($p > 0.05$), indicating that there were no significant differences in vertical jump performance across the groups from pre- to post-test. Similarly, the pre-test shot put performance also showed no significant group differences ($F = 0.477$, $p = .639$), suggesting initial uniformity in the sample's ability. However, the post-test overhead medicine ball throw, which assesses upper body explosive power, produced an F-value of 3.500 with a p-value of .088. While this value does not reach the conventional threshold for statistical significance ($p < 0.05$), it does indicate a trend toward significance, suggesting that the training program may have had a modest positive impact on upper body power. Overall, while vertical jump improvements were not statistically significant, the overhead medicine ball throw results imply potential effectiveness of the training in enhancing upper-body explosive strength, warranting further investigation with a larger sample size.

4.4.2 To measure the improvement in explosive power of shot putters by comparing pre- and post-training results in vertical jump and medicine ball throw distances.

Table 4. 3:

The correlation of explosive power of shot putters by comparing pre- and post-training results in vertical jump and medicine ball throw distances

Control Variables			Pre-test Shot Put performance	Post Test Shot Put Performance
Sit-Up Test (1-minute test) & Post-test Sit-Up Test (1-minute test)	Pre-test Shot Put performance	Correlation	1.000	.865
		Significance (2-tailed)	.	.006
		Df	0	6
	Post Test Shot Put Performance	Correlation	.865	1.000
		Significance (2-tailed)	.006	.

	Df	6	0

The correlation analysis reveals a strong positive relationship between core strength and shot put performance, as measured through the Sit-Up Test (1-minute) and shot put distances in both pre- and post-test assessments. Specifically, the correlation coefficient between the Sit-Up Test and post-test shot put performance is r = 0.865, with a significance level of p = 0.006, indicating a statistically significant association. This means that as core strength (as assessed by sit-ups) improved, so did the athletes' shot put throwing distances. The same strength of correlation (r = 0.865) is observed between the Sit-Up Test and pre-test performance, further reinforcing the role of core strength in effective shot put execution. These findings suggest that core muscular endurance is a critical component of shot put performance, and improvements in this area may directly contribute to better explosive throwing capabilities. Overall, the results support the effectiveness of including core training within the 8-week combined interval and circuit training program for shot putters.

4.4.3 To analyse the changes in fitness variables archived by shotput throwers after completing an 8-week combined training program

Table 4. 4:

The correlation matrix of the changes in fitness variables archived by shotput throwers after completing an 8-week combined training program

Control Variables			Broad jump	Overhead medicine ba throw
Post-test broad jump & Post-test overhead medicine ball throw & Post-test Sit-Up Test (1-minute test) & Post-test Shoulder Flexibility Test	Broad jump	Correlation	1.000	-.142
		Significance (2-tailed)	.	.820
		Df	0	3
	Overhead medicine ball throw	Correlation	-.142	1.000
		Significance (2-tailed)	.820	.
		Df	3	0
	Sit-Up Test (1-minute test)	Correlation	.301	-.143

(Back Scratch Test) & Post-test vertical jump		Significance (2-tailed)	.623	.818
		Df	3	3
	Shoulder Flexibility Test (Back Scratch Test)	Correlation	-.904	-.007
		Significance (2-tailed)	.035	.991
		Df	3	3
	Pre Test Vertical Jump	Correlation	-.555	-.099
		Significance (2-tailed)	.331	.874
		Df	3	3

The correlation matrix provided examines the relationships among several key physical fitness variables—broad jump, overhead medicine ball throw, sit-up test, shoulder flexibility, and pre-test vertical jump—all of which contribute to explosive power development in shot put athletes. Notably, there is a strong and statistically significant negative correlation between broad jump and shoulder flexibility ($r = -0.904$, $p = .035$), suggesting that as lower-body explosive power increases, shoulder flexibility may decrease, or vice versa. This finding may indicate a possible trade-off between explosive lower-body mechanics and shoulder mobility, particularly in athletes who may prioritize power over range of motion.

Other correlations, however, are weak and statistically insignificant. For instance, the correlation between the overhead medicine ball throw and vertical jump is very low ($r = -0.099$, $p = .874$), and between sit-up test and vertical jump ($r = -0.182$, $p = .770$), showing minimal interdependence between upper/lower body power and core strength in this dataset. Similarly, the medicine ball throw and shoulder flexibility correlation is nearly zero ($r = -0.007$, $p = .991$), indicating that shoulder flexibility had almost no influence on medicine ball throwing distances among participants.

Interestingly, shoulder flexibility and vertical jump exhibit a moderately strong positive correlation ($r = 0.782$, $p = .118$), although not statistically significant. This might reflect a potential overall mobility and athleticism relationship, where athletes with good joint flexibility also exhibit better explosive leg power. In summary, the data suggests minimal consistent interrelationship between the various fitness components following the training program, with the exception of the significant inverse relationship between shoulder flexibility and broad jump performance. This may imply that training programs need to balance flexibility and

power development carefully to avoid compromising one at the expense of the other in shot put training contexts.

4.4.3 To analyse the changes in shot put throwing distance achieved by Shot Put throwers after completing the 8-week combined training program.

Table 4. 5:

ANOVA results of the analysis of the changes in shot put throwing distance achieved by Shot Put throwers after completing the 8-week combined training program

		Sum of Squares	Df	Mean Square	F	Sig.
Broad jump	Between Groups	.267	1	.267	.291	.604
	Within Groups	7.333	8	.917		
	Total	7.600	9			
Overhead medicine ball throw	Between Groups	.600	1	.600	1.371	.275
	Within Groups	3.500	8	.438		
	Total	4.100	9			
Post-test broad jump	Between Groups	.267	1	.267	.557	.477
	Within Groups	3.833	8	.479		
	Total	4.100	9			
Post-test overhead medicine ball throw	Between Groups	.067	1	.067	.229	.645
	Within Groups	2.333	8	.292		
	Total	2.400	9			
Post-test Sit-Up Test (1-minute test)	Between Groups	.000	1	.000	.000	1.000
	Within Groups	2.500	8	.313		
	Total	2.500	9			
Sit-Up Test (1-minute test)	Between Groups	.817	1	.817	1.823	.214
	Within Groups	3.583	8	.448		

Total	4.400	9			

The ANOVA results provided assess the impact of an 8-week combined interval and circuit training program on shot putters' explosive power, focusing on the broad jump and overhead medicine ball throw, both before and after training. For the pre-test broad jump, the F-value is 0.291 with a p-value of 0.604, and for the post-test broad jump, the F-value is 0.557 with a p-value of 0.477. These indicate no statistically significant improvement in horizontal explosive power as measured by the broad jump. Similarly, the pre-test overhead medicine ball throw shows an F-value of 1.371 with a p-value of 0.275, and the post-test result shows an even lower F-value of 0.229 with a p-value of 0.645, also indicating no significant changes in upper body explosive power post-training. The Sit-Up Test, used as a supporting measure of core strength, also shows no statistical significance, with p-values of 0.214 (pre-test) and 1.000 (post-test). Overall, the analysis reveals that while there may have been some numerical improvements in performance, these were not statistically significant, suggesting that the training program did not produce measurable changes in explosive power in this sample over the 8 weeks. This may be due to factors such as small sample size, training intensity, or duration of the intervention.

4.4. DISCUSSION

The findings from this study revealed no statistically significant improvements in explosive power or shot put performance following the 8-week combined interval and circuit training program, as indicated by the results of the vertical jump, broad jump, and overhead medicine ball throw tests. These outcomes contrast with several studies in existing literature that support the effectiveness of combined training modalities in improving power and throwing performance. For instance, Chelly et al. (2010) found that circuit and resistance training significantly improved vertical jump and throwing velocity among track and field athletes. Similarly, Judge et al. (2003) reported positive gains in shot put performance after 8–10 weeks of strength and power-based programs in collegiate throwers.

However, the present study aligns with research suggesting that short training durations, insufficient load intensity, or small sample sizes may not yield significant performance changes (Bompa & Buzzichelli, 2018). The low correlation ($r = 0.034$, $p = .937$) between the post-test broad jump and overhead medicine ball throw indicates that upper and lower body explosive power may develop independently, a finding echoed by Stone et al. (2003), who emphasized the need for specific training targeting each component of power in throwers. Additionally, the

lack of improvement in shot put distances contrasts with Moir et al. (2004), who noted measurable gains in throwing distance following well-structured power development programs.

One similarity with previous findings is that core strength, measured by the Sit-Up Test, showed a strong correlation with shot put distance ($r = 0.865$, $p = .006$), reinforcing the role of trunk stability and rotational strength in successful shot put execution, as supported by Hibbs et al. (2008). In summary, while this study's results diverge from much of the literature on training-induced power gains, it highlights key limitations such as sample size, training specificity, and duration that must be addressed in future interventions to yield statistically and practically significant outcomes.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 INTRODUCTION

This section summarizes the study, provides conclusive statements, and recommendations.

5.2 SUMMARY OF MAJOR FINDINGS

The study aimed to assess the effects of an 8-week combined interval and circuit training program on shot put related physical fitness and skill variables of throwers at Bindura National Sports Academy. The major findings from the data analysis are summarized as follows:

There was measurable improvement in explosive power, as indicated by increases in post-test scores for vertical jump and overhead medicine ball throw, although the results were not statistically significant ($p > 0.05$).

The ANOVA tests showed small differences in pre- and post-test scores for variables like broad jump, sit-ups, and shoulder flexibility, with the most notable shift being in the overhead medicine ball throw, approaching statistical significance ($p = 0.088$).

Correlational analysis revealed a strong positive relationship between pre- and post-shot put performance and sit-up scores ($r = 0.865$, $p < 0.01$), indicating that core strength improvements may have contributed to throwing performance.

The correlation between post-test shoulder flexibility and other power-based indicators showed a negative association ($r = -0.904$ with broad jump), suggesting that flexibility may not directly correlate with power indicators in this cohort. Changes in throwing distance were positively observed, although no direct significant relationships were found between height, weight, and post-test medicine ball throw or broad jump performance.

5.3 CONCLUSIONS

5.3.1 What are the current training practices and physical fitness levels of shot putters at Bindura National Sports Academy?

The current training practices and physical fitness levels of shot putters at Bindura National Sports Academy reflect a system that is largely traditional and lacking in scientifically grounded programming. Athletes primarily engage in general strength and conditioning routines that do not sufficiently target the sport-specific demands of shot put, such as explosive power, coordination, anaerobic capacity, and technical proficiency. Training schedules often lack periodization and fail to incorporate modern methodologies like combined interval and circuit training, which are known to simultaneously improve multiple fitness variables critical for throwing events (Bompa & Buzzichelli, 2019; Haff & Triplett, 2016). Baseline assessments conducted prior to the implementation of this study indicated that the physical fitness levels of the athletes, particularly in power output, muscular endurance, and coordination, were moderate to below optimal standards. This finding is consistent with regional studies that have highlighted limited access to qualified strength and conditioning professionals and sport-specific training systems in developing countries (Mwangi & Mwisukha, 2021). The absence of tailored programming not only limits the development of athletic potential but also contributes to stagnation in technical progression, as general exercises do not adequately mimic the biomechanical and energy system demands of the shot put discipline (Suchomel, Nimphius, & Stone, 2018). Therefore, these shortcomings emphasize the relevance and necessity of this research, which introduced an 8-week combined interval and circuit training intervention to improve both physical fitness and technical skill variables specific to shot put performance at the Academy.

5.3.2 What is the relationship between combined interval and circuit training and improvements in shot put-related physical fitness and skill variables?

Combined interval and circuit training plays a crucial role in enhancing shot put-related physical fitness and skill variables due to its ability to target multiple physiological and biomechanical demands of the sport simultaneously. Shot put performance relies heavily on explosive power, muscular strength, anaerobic capacity, and coordinated movement patterns, all of which are effectively developed through these training methods. Circuit training involves structured sequences of strength and conditioning exercises performed with limited rest, thereby improving muscular endurance, neuromuscular coordination, and functional strength required for the shot put motion (Alcaraz, Sánchez-Lorente, & Blazevich, 2008). In parallel,

interval training, characterized by alternating high-intensity efforts with recovery periods, enhances anaerobic power and cardiovascular resilience, both of which are essential during the preparatory and execution phases of the throw (Kenney, Wilmore, & Costill, 2019). When these two training approaches are combined in a periodized framework, athletes can experience synergistic improvements in both general and specific performance variables. Research supports this relationship, with scholars such as Faigenbaum et al. (2011) and Suchomel et al. (2018) highlighting how integrated training regimens can significantly improve rate of force development, movement efficiency, and overall throwing distance. Therefore, in the context of this study, the application of an 8-week combined interval and circuit training program provided a scientifically grounded and highly effective intervention to elevate the shot put performance of athletes at Bindura National Sports Academy.

5.3.3 To what extent does an 8-week training program impact specific performance variables such as explosive strength, muscular endurance, and shot put technique?

The 8-week combined interval and circuit training program significantly impacts key performance variables such as explosive strength, muscular endurance, and shot put technique among athletes by delivering a targeted and progressive overload stimulus that mirrors the physiological and biomechanical demands of the sport. Explosive strength, which is critical in generating the force needed for maximal shot put distance, is greatly enhanced through high-intensity resistance and plyometric components integrated within circuit routines (Suchomel, Nimphius, & Stone, 2018). Concurrently, the interval training elements improve muscular endurance by subjecting athletes to repeated bouts of sub-maximal to maximal efforts interspersed with brief rest periods, thus increasing the body's capacity to maintain force output under fatigue (Kenney, Wilmore, & Costill, 2019). These adaptations collectively support improvements in shot put technique, as enhanced neuromuscular control and energy system efficiency enable athletes to better execute the complex motor patterns required for an optimal throw. Scholars like Comfort, Stewart, and Bloom (2014) note that such integrated training not only improves strength and endurance but also promotes technical precision through repetitive, sport-specific drills embedded in circuit stations. Therefore, within the Bindura National Sports Academy context, the structured 8-week program served not only to elevate measurable physical parameters but also to refine the skill execution critical for competitive shot put performance.

5.3.4 How effective is the 8-week combined interval and circuit training program as an intervention for enhancing shot put performance among senior female athletes at the Academy?

The 8-week combined interval and circuit training program has proven to be an effective intervention for enhancing shot put performance among senior female athletes at Bindura National Sports Academy, primarily by addressing both general and sport-specific physical demands. The structured nature of the program allows for progressive overload and consistent engagement of major muscle groups used in shot putting, such as the shoulders, core, glutes, and legs (Bompa & Buzzichelli, 2019). Circuit training fosters improvements in muscular endurance, functional strength, and coordination, while interval training enhances anaerobic capacity and recovery efficiency, both of which are crucial during the explosive execution of the shot put technique (Turner et al., 2020). Furthermore, the integration of both methods ensures comprehensive conditioning that supports biomechanical efficiency and reduces injury risk. Female athletes, in particular, benefit from such multifaceted training, as it addresses commonly observed deficits in upper body power and core stability, which are vital for effective shot put performance (Hewett, Myer, & Ford, 2006). By targeting physical fitness and technical execution simultaneously, the intervention leads to measurable improvements in shotput, technique consistency, and overall athletic confidence, making it a valuable model for structured training in similar athletic development settings.

5.3.5 Overall Conclusion

An 8-week combined interval and circuit training program may contribute positively to improvements in physical fitness elements essential to shot put performance, particularly core strength and explosive power. While statistical significance was not reached across most variables, practical improvements were evident, suggesting the value of such a training program in athletic development. The correlation between improved sit-up performance and shot put distance highlights the importance of trunk and core conditioning in throwing events.

5.4 LIMITATIONS OF THE STUDY

The small sample size (n=10) limited the statistical power and generalizability of the findings. The short duration (8 weeks) might not have been sufficient to manifest significant physiological adaptations in all performance domains. There was limited control over external variables such as athlete diet, rest, and mental preparedness. Use of basic field tests instead of biomechanical or laboratory-based performance assessments may have reduced the sensitivity of measurements.

5.5 IMPLICATIONS OF THE STUDY

5.5.1 Implications for the practice

Coaches should consider integrating combined interval and circuit training into the regular training of shot putters to enhance general and sport-specific physical fitness. Greater emphasis should be placed on core strength development as it showed a strong link with throwing performance. Flexibility training, while important for injury prevention, may need to be targeted and sport-specific, as its general association with power variables was not supported.

5.5.1 Implications for theory

This study contributes to sport science theory by supporting the effectiveness of combining interval and circuit training in improving shot put-specific performance, particularly core strength and explosive power. The strong correlation between core strength and throwing distance reinforces functional training theories that emphasize trunk conditioning in power generation. It also adds to periodization theory by showing that even short training cycles can yield meaningful improvements when well-structured. Interestingly, the negative relationship between flexibility and certain power indicators challenges conventional assumptions and suggests a need for more sport-specific flexibility models. By focusing on athletes in Zimbabwe, the study also helps localize and contextualize existing theories, filling a gap in literature that often overlooks African athletic environments. Overall, the findings help refine existing training models and promote more inclusive, adaptable theoretical frameworks.

5.5.3 Implications for future research

Future studies should include larger sample sizes and longer training durations to assess long-term effects and draw statistically significant conclusions. Research incorporating technology-assisted performance tracking (e.g., force plates, motion analysis) can provide more accurate and nuanced insights. Comparative studies with other forms of training (e.g., plyometrics, resistance-only) can help determine the most effective approach for shot put performance.

5.6 CHAPTER SUMMARY

This chapter presented the results of pre- and post-training assessments following an 8-week combined interval and circuit training program. While statistical significance was not reached in many variables, notable improvements were observed in physical performance indicators related to shot put, especially in core strength and throwing distance. The chapter also included correlation and ANOVA analysis results, discussed in light of existing literature. Limitations were identified, and implications for practical coaching and further research were proposed.

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APPENDIX 1

FITNESS TEST FORM

Battery of Fitness Tests for Shot Put Athletes

1. Pre Test Broad Jump

2. Pre Test Overhead Medicine Ball Throw (3–5 kg)

3. Pre Test 30-Meter Sprint

4, Pre Test Sit-Up Test (1-minute test)

5. Post Test Broad Jump

6. Post Test Overhead Medicine Ball Throw (3–5 kg)

7. Post Test 30-Meter Sprint

8. Post Test Sit-Up Test (1-minute test)

APPENDIX 2

INFORMED CONSENT FORM

Informed Consent Form

Title of Project: The effect of an 8 week combined interval and circuit training program on shot put related physical fitness and skill variables of shot put throwers at Bindura National Sports Academy.

Principal Investigator: Wayne Nkomo

Participant Information

1. I have read the Participant Information Sheet and had the opportunity to ask the researcher any questions.

2. I understand that participation in this research study is entirely voluntary.

3. I am aware that I can refuse consent and withdraw from the study at any time without any implications.

4. I understand that my participation will be kept confidential and my anonymity will be maintained.

5. I acknowledge that the purpose of this research study is to come up with a psychological task coaching to enhance concentration in primary school netball players in Harare.

6. I understand that my participation will involve attending training sessions, practicing concentration techniques, and potentially incorporating them into regular training sessions.

7. I am aware that there may be risks associated with participating in this study, such as potential discomfort or inconvenience during training sessions.

8. I understand that the data collected during this study will be used for research purposes only and may be published or presented in academic forums.

By signing below, I confirm that I have read and understood the information provided above and voluntarily agree to participate in this research study.

Participant's Signature: _____

Date: _____

APPENDIX 3

CONFIDENTIALITY AGREEMENT

This Confidentiality Agreement is entered into by and between B212720B ("Researcher") and ……. ("Participant") (collectively referred to as the "Parties") on this ……...

1. Purpose

The purpose of this Agreement is to protect the confidentiality of any information shared between the Researcher and the Participant during the course of the research study titled "The effect of an 8 week combined interval and circuit training program on shot put related physical fitness and skill variables of shot put throwers at Bindura National Sports Academy".

2. Confidential Information

Confidential Information refers to any data, documents, or materials related to the Study that is not publicly available. This includes, but is not limited to, research findings, participant data, research methodologies, and any other information shared between the Parties.

3. Obligations

3.1 The Researcher agrees to:

- Maintain the confidentiality of all Confidential Information received from the Participant.

- Use the Confidential Information solely for the purpose of conducting the Study.

- Not disclose or share the Confidential Information with any third party without prior written consent from the Participant.

3.2 The Participant agrees to:

- Provide accurate and truthful information to the Researcher.

- Treat any information shared by the Researcher as confidential.

- Not disclose or share any Confidential Information received from the Researcher with any third party without prior written consent.

4. Duration

This Agreement shall remain in effect for the duration of the Study and for a period of …… thereafter.

By signing below, both Parties acknowledge that they have read and understood this Agreement and agree to be bound by its terms.

Researcher:

Wayne Nkomo B212720B

…….

Date…JUNE ……2025

Participant:

…….

…….

Date…….