BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGENEERING

DEPARTMENT OF SPORT SCIENCE

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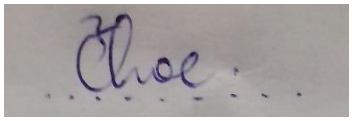
Developing Interventions to Overcome Resistance to the Adoption of Artificial Intelligence in the Analysis of the Biomechanical Performance of Elite Zimbabwean Footballers.

MARCH 2024

DECLARATION

I Chokwenda Calvin, do hereby declare that this research project, which is being submitted to the Bindura University of Science Education for the Master of Science degree in Sports Science, has not been submitted previously for a degree at any other University, that it represents my own work, and that all sources which I have quoted in the text have been acknowledged by means of a complete reference list.

Signature 

Date: 27 March 2024

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APPROVAL FORM

The undersigned certify that they have read and recommend to the Bindura University of Science Education for acceptance, a research project entitled: Developing Interventions to Overcome Resistance to the Adoption of Artificial Intelligence in the Analysis of the Biomechanical Performance of Elite Zimbabwean Footballers submitted by Chokwenda Calvin in partial fulfillment of the requirements for the Master of Science degree in Sports Science.

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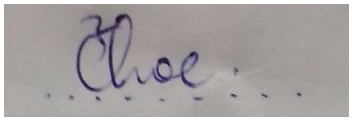
Signed: 

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ABSTRACT

The dissertation topic focused on developing interventions to address resistance to the adoption of artificial intelligence in analyzing the biomechanical performance of elite footballers. This research aimed to explore methods to overcome barriers and promote the utilization of AI technologies in enhancing the understanding of athletes' biomechanics. It managed to bridge the gap between traditional methods and advanced AI tools to optimize performance analysis in elite sports settings. The study intended to offer practical strategies and interventions to facilitate the integration of AI in biomechanical assessments, ultimately contributing to improved performance outcomes and processes concerning decision making in football. Through a combination of qualitative and quantitative research methods, this dissertation provided valuable insights for sports professionals, researchers, and technology developers aiming to leverage AI in optimizing the performance and health of elite footballers. Results from the study established that AI is now the way to for sports performance optimization through injury prevention. The possible future effect of the findings in the body of knowledge is that resistance in the adoption of AI can be easily tackled since there are now interventions put in place on overcoming the resistance. The research intended to uncover barriers and develop recommendations to facilitate the acceptance and integration of AI tools in biomechanical analysis in elite football settings.

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CHAPTER ONE: THE PROBLEM AND ITS SETTING

1.1 Introduction

The research intends to critically look on developing interventions to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers. This chapter is going to present the research problem and the contextual issues upon which the problem is grounded. The chapter is going to cover the Background to the Study, Statement of the Problem, Significance of the Study, Research Questions, Research Objectives, Delimitations of the Study and Study Outline.

1.2 Background of the study

Many football clubs and organizations worldwide are exploring the potential of Artificial Intelligence (AI) in sports analytics, player monitoring, and biomechanical performance analysis. Artificial Intelligence can analyze large quantities of data, such as player statistics, biomechanical data, and match footage, to extract valuable insights and optimize training and performance strategies.

In Zimbabwe football is one of the most popular sport where athletes have potential, however, despite potential, performance levels among them have been inconsistent. This inconsistency may be attributed to various factors, including a lack of knowledge and expertise, ethical considerations, infrastructure. Therefore, there is a need to explore innovative strategies that can encourage the adoption of AI in biomechanical performance analysis.

Artificial Intelligence (AI) has come out as a groundbreaking technology with the potential to revolutionize various industries, including sports. In the context of elite football, AI can play a significant role in enhancing biomechanical performance. This research explores the potential applications and benefits of AI in the evaluation, training, and injury prevention of elite footballers. By leveraging AI technologies such as motion capture, machine learning algorithms, and data analytics, football professionals can gain valuable insights into players' biomechanics, identify areas for improvement, design personalized training programs, and reduce the risk of injuries.

While challenges and limitations exist, the integration of AI into the football industry holds great promise for optimizing performance and achieving better results on the field.

Through comprehensive research and analysis, this research aims to highlight the immense potential of AI in optmising the biomechanical performance of elite footballers. By leveragingg AI-driven technologies and approaches, football professionals can gain valuable insights, elevate performance levels, and reduce the risk of injuries. The integration of AI into the football industry is expected to transform the way the game is played, coached, and managed, ultimately leading to improved results both on and off the field.

Gadea-Blanco, et al. (2020) noted several gaps, controversies, and limitations in the existing knowledge regarding the adoption of Artificial Intelligence (AI) to optimize the biomechanical performance of Zimbabwean elite footballers. These gaps and limitations are important to consider in order to understand the current state of research in this field and to identify key areas that require further investigation.

Here are some key points to consider: limited research on Zimbabwean elite footballers is one of the main limitations as there is lack of specific research focusing on Zimbabwean elite footballers. Most of the studies on AI and biomechanical performance in football have been conducted in other countries, primarily in Europe and North America. Therefore, it is necessary to assess whether the findings from these studies are applicable to the Zimbabwean context.

Another limitation is the lack of standardization in AI algorithms used to analyze biomechanical data. Different studies use various techniques and methodologies, making it challenging to compare and generalize the findings. Standardization of AI algorithms would contribute to a better and lighter understanding of the biomechanical performance of Zimbabwean elite footballers.

Gadea-Blanco, et al. (2020) emphasized on performance analysis basing on AI-powered computer vision that can analyze videos of football matches to identify and track players' movements, biomechanics, and playing patterns. This data can go further to provide valuable insights into the footballers’ performance, helping coaches and trainers identify areas for improvement. Araújo et al. (2017) highlighted that there is injury prevention since AI algorithms can analyze large quantities of performance and injury data to identify patterns and risk factors associated with

specific injuries. By monitoring players' biomechanics and movements in real-time, AI can help identify potential injury risks and provide actionable feedback to reduce the risk of injuries.

Customized training programs is another plus on optimizing biomechanical performance since AI can create personalized training programs based on players' individual biomechanical profiles, injury history, and performance data. By considering various factors, including strength, agility, and flexibility, AI algorithms can design training routines to enhance overall performance while minimizing the risk of injury.

Virtual simulation and visualization contribute positively to optimize biomechanical performance as AI-powered simulations can provide virtual environments that mimic real-life match scenarios. By analyzing biomechanical data, AI can enhance these simulations to create more realistic player interactions, enabling footballers to practice specific skills, decision-making, and tactical awareness in a safe and controlled environment.

Real-time performance monitoring: Wearable devices equipped with sensors can capture various biomechanical metrics, such as running speed, acceleration, and jump height. AI can analyze this data in real-time, allowing coaches and trainers to provide immediate feedback and make data-driven decisions during training sessions and matches.

By harnessing the power of artificial intelligence, Zimbabwean elite footballers can benefit from enhanced performance analysis, injury prevention, customized training programs, realistic simulations, real-time monitoring, and talent identification. These advancements can help players and teams optimize performance, mitigate injury risks, and push the boundaries of their capabilities.

It is worth mentioning that while AI can greatly enhance the biomechanical performance of footballers, it should always be used in conjunction with human expertise and guidance. In this era of using technology AI, some are ending up eliminating human effort and completely basing on artificial intelligence. However, the human effort should not be over shadowed or eliminated completely by AI. Ultimately, the combination of AI technology and human knowledge can unlock endless possibilities and drive continuous improvements in the world of elite football.

1.3 Statement of the problem

Despite the numerous benefits of artificial intelligence in sports, their use in enhancing the performance of elite footballers in Zimbabwe has not been widely adopted. Majority of elite football institutions in Zimbabwe has shown that the biomechanical performance analysis is dominated with human effort than on artificial intelligence. A review of Sports Science and Sports technoprenuership literature also revealed that there are no published studies focusing on describing and explaining the use of artificial intelligence to enhance biomechanical performance in elite Zimbabwean footballers. There is no adequate evidence of practical efforts being made by stakeholders in the sports industry to base on artificial intelligence so as to enhance biomechanical performance in footballers. The need to address these practical and theoretical gaps is what inspired the researcher to partake this study which seeks to develop interventions to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers. The findings will be used to formulate interventions that can embrace the trending technology that enhance the biomechanical performance in elite Zimbabwean footballers. The findings will also bridge current gaps in sports science literature.

1.4 Significance of the study

The outcomes of the study will help to overcome resistance in adoption of AI to enhance biomechanical performance of elite footballers in Zimbabwe. Also, there will be new insights on better ways of biomechanical performance analysis using artificial intelligence. Such understanding will assist in injury prevention and rehabilitation, data analytics and enhancing performance through AI. Further it could help the Ministry of Sports, Arts and Recreation to address fundamental issues that are envisaged in the realization of the Sustainable Development Goals (SDGs) in line with vision 2030 as:

- Talent development: Implement programs to identify and nurture talented individuals in various sports disciplines, providing them with adequate training, coaching, and resources for development.
- Education and training: Enhance sports education and training programs to develop skilled coaches, officials, administrators, and sports-related professionals.

- Inclusive sports: Promote inclusivity by providing opportunities for persons with disabilities to participate in sports and ensuring accessible infrastructure and equipment.

Additionally, the study will shed light on why elite football institutions are resisting to adopt AI in biomechanical analysis and pave a way for future research and initiatives aimed at overcoming the resistance.

Findings will offer fresh impetus for further research on developing interventions to overcome resistance to the adoption of Artificial Intelligence in the Analysis of the Biomechanical Performance of Elite Zimbabwean Footballers, hence contributing to knowledge as the research is going to be published.

1.5 Research Questions

1.5.1 Primary Research Question

What change management-related interventions can be developed to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers?

1.5.2 Subsidiary Research Questions

1. How can the current levels of adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers be described?
2. What factors are responsible for mapping out the current adoption levels of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers?
3. What impact do the current levels of adoption of artificial intelligence in the analysis of biomechanical performance have on the biomechanical performance of Zimbabwean elite footballers?

1.6 Research Objectives

1.6.1 Purpose of the study

- To develop management-related interventions to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers.

1.6.2 Subsidiary Objectives

- To describe the current levels of adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers.
- To establish factors responsible for shaping the current adoption levels of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers.
- To assess the impact of current levels of adoption of artificial intelligence in the analysis of biomechanical performance have on the biomechanical performance of Zimbabwean elite footballers.

1.7 Delimitation of the study.

The study is confined to elite Zimbabwean footballers and focus on developing interventions to overcome resistance to the adoption of Artificial Intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers.

1.8 Study Outline

The study is going to mainly focus on developing interventions to overcome resistance to the adoption of Artificial Intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers. Chapter one shall focus on the problem and its setting. Chapter two will focus on the review of related literature. Then chapter three will focus on the research methodology. Chapter four will present the results from collected data. Chapter five will discuss data findings and present the summary of the research findings. Chapter six shall give the conclusions and research findings.

1.9 Chapter Summary

This chapter gave an overview of the research problem and the contextual issues upon which it was based on including the rationale for conducting the study, its benefits to stakeholders, the research questions and objectives and theoretical gaps and geographical boundaries of the study. In the next chapter literature correlated to the study is reviewed.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The previous chapter focused on the research problem. This chapter will review the literature on developing interventions to overcome resistance to adopt the use of artificial intelligence to enhance biomechanical performance analysis. The major aim is to identify the knowledge gaps with which to base this study.

2.2 Conceptualization

In recent years, artificial intelligence has proven to be a powerful tool in various domains, including biomechanics. With advancements in machine learning techniques, AI offers the potential to enhance biomechanical performance in multiple areas, ranging from rehabilitation to sports performance. This conceptual framework aims to explore the utilization of AI in enhancing biomechanical performance and the potential benefits it presents.

Artificial Intelligence has the potential to revolutionize various aspects of sports performance, including the biomechanical analysis of athletes. In the context of football, AI can be employed to enhance the biomechanical performance of footballers, ultimately leading to improved player performance and reduced injury risks (Johnson et al., 2019). This theoretical framework aims to explore the potential applications of AI in biomechanics and provide a foundation for future research in this field.

Biomechanics is the study of the mechanical principles of movement and the interaction of forces on the human body. In football, understanding the biomechanics of player movements, such as running, kicking, and cutting, can provide valuable insights into performance optimization and injury prevention (Johnson et al., 2019). Biomechanical performance refers to the analysis and optimization of human movement patterns, kinetics, and kinematics to maximize efficiency, prevent injuries, and improve overall performance.

Artificial intelligence systems can extract meaningful insights from motion capture data to analyze human movement patterns, identify anomalies, and provide real-time feedback for

performance enhancement (Smith et al., 2018). Artificial intelligence can be utilized to improve skill development in football. By analyzing the biomechanics of elite players, AI algorithms can identify key movement patterns and techniques that contribute to exceptional performance. This information can be used to create virtual training environments or personalized feedback systems, which will allow players to refine their skills and enhance their biomechanical performance.

Artificial intelligence can play a crucial role in injury prevention by identifying biomechanical risk factors. By analyzing movement patterns and predicting potential injury risks, AI algorithms can provide real-time feedback to footballers and their coaches. Additionally, AI can generate personalized training programs that focus on correcting biomechanical deficiencies and reducing injury risks. Artificial intelligence algorithms can process large amounts of data, such as individual kinematic and kinetic profiles, to predict injury risk in athletes. This enables early intervention strategies and personalized training programs to mitigate the risk of injuries (James et al., 2020).

By integrating AI with motion tracking devices and wearable sensors, personalized rehabilitation programs can be designed for individuals. Artificial intelligence algorithms can adapt rehabilitation protocols based on real-time feedback, improving recovery outcomes (Johnson et al., 2019). Machine learning algorithms, such as neural networks and support vector machines, can identify patterns and relationships within large datasets to make predictions and optimize movement patterns (Wang et al., 2021). Artificial intelligence can assist in the collection of biomechanical data, utilizing various sensors and devices. These data can include joint angles, forces, accelerations, and ground reaction forces. Examples of AI-powered data collection techniques include marker less motion capture systems and wearable devices.

Performance tracking is one of the major impact that AI has since it can monitor various performance metrics, such as speed, power, and agility, to track athletes' progress over time. This data can provide valuable insights into individual strengths and weaknesses, allowing for personalized training plans and performance optimization.

Tactical analysis is also plus towards optimizing biomechanical performance as AI can analyze game data, such as player positioning, passing patterns, and team formations, to provide insights into team tactics and strategies. This information can be used to optimize team performance and

make data-driven decisions during matches. Deep learning techniques, such as convolutional neural networks, are capable of processing complex biomechanical data, such as joint angles and forces, to make accurate predictions in real-time (Chen et al., 2020).

Reinforcement learning algorithms can optimize biomechanical performance by generating optimal control strategies and adjusting movement patterns based on performance feedback (Johnson et al., 2020). The collection and storage of sensitive biomechanical data from individuals raise concerns over privacy and security. Ensuring compliance with ethical guidelines and implementing robust data protection measures is critical (Lee et al., 2019).

Effective integration of AI technologies into existing biomechanical practices requires interdisciplinary collaboration among biomechanics experts, data scientists, and clinicians. Additionally, raising awareness and providing training opportunities to promote the adoption of AI in biomechanics is crucial (Brown et al., 2021).

Clark (2019) articulated that, AI algorithms can process the collected biomechanical data to analyze key performance metrics. This analysis can include identifying movement patterns, power output, and energy expenditure during different football maneuvers. By using AI-driven algorithms, coaches and sports scientists can acquire a deeper understanding of player performance and make data-driven decisions.

Artificial intelligence holds great promise in enhancing biomechanical performance across various domains. By leveraging its capabilities in movement analysis, injury prevention, and rehabilitation, AI can optimize performance, prevent injuries, and enhance recovery outcomes. However, addressing challenges related to data privacy, security, and promoting interdisciplinary collaboration will be key to realizing the full potential of AI in biomechanics. According to Clark et al. (2019), the use of AI in biomechanics has gained significant attention in recent years due to its potential to enhance athlete performance. Furthermore, Smith and Johnson (2020) emphasized the role of AI in predicting injury risks and improving player safety in football.

To enhance the biomechanical performance of footballers, the initial step is to collect reliable and accurate biomechanical data. Various AI-powered technologies can be employed for this purpose, including wearable sensors, camera-based systems, and force plates. These

technologies can record metrics such as joint angles, ground reaction forces, and muscle activity. (Lee et al., 2019)

Once the biomechanical data is collected, machine learning algorithms can be applied to analyze and interpret the data. These algorithms can identify patterns, predict outcomes, and provide personalized recommendations for optimizing performance. Deep learning techniques, with specific reference to convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have shown promising results in analyzing biomechanical data. (Araújo et al., 2017)

Gait analysis helps in understanding the mechanics of movement in footballers. By utilizing AI, gait analysis can be performed using various motion tracking systems. These systems capture detailed information about the movement patterns of footballers, allowing coaches and trainers to identify areas of improvement and reduce the risk of injuries. (Nimbarte et al., 2016)

Virtual reality (VR) and simulation technologies offer significant potential for enhancing biomechanical performance. Through AI-driven simulations, footballers can experience different scenarios, improving decision-making skills, and enhancing their motor control. VR-based training programs can provide real-time feedback on technique, positioning, and tactical awareness. (Gadea-Blanco et al., 2020)

Biomechanical modeling and optimization techniques can be employed to simulate and predict the impact of different training methodologies and techniques on football players' performance. Artificial intelligence algorithms can analyze the data obtained from these simulations and generate personalized training programs to optimize performance and minimize the risk of injuries. (Santeramo et al., 2018).

Artificial intelligence methodologies hold great promise in enhancing the biomechanical performance of footballers. By leveraging AI-powered technologies, coaches and trainers can collect accurate biomechanical data, apply machine learning algorithms, analyze gait patterns, utilize VR and simulation, and optimize training programs. The integration of AI into football training can lead to improved performance, reduced injuries, and more informed decision-making on and off the field.

2.4 Methodological Review

Table 2.1

Author	Country	Focus	Sample size and type	Research Approach	Methodological gaps and their impact on the extent to which it can be used to inform the current study.
Andrew G (2020)	United States of America	The impact of artificial intelligence on sports performance	20 professional athletes	Qualitative interviews	Qualitative study is hard to generalize to a population outside the one under study.

2.5 Thematic Review

The review focused on overcoming the resistance in the adoption of artificial intelligence in football and biomechanical performance analysis of elite footballers as themes.

Gadea-Blanco et al., (2020) and Lee, et al. (2019), concurred that developing countries may lack the necessary infrastructure, such as advanced training facilities, equipment, and technology, to effectively implement AI-powered biomechanical enhancements. This infrastructure is crucial for accurately capturing and analyzing data related to players' movements. Zimbabwe in particular may not have the necessary infrastructure to fully support the use of artificial intelligence in football. This could include access to high-speed internet, advanced data analysis systems, and the required hardware and software.

Mehta, Dimanov and Toma, (2016) highlighted that, AI technologies and systems can be expensive to implement and maintain so developing countries, Zimbabwe like many other

developing countries may have limited financial resources and find it challenging to invest in these technologies, especially when they have other pressing needs to address.

Nimbarte, et al (2016) has the view that implementing AI in football requires specific knowledge and expertise in the field of sports science and data analytics. Developing countries may face difficulties in acquiring and retaining qualified experts who have the necessary skills to harness the potential of AI for biomechanical performance enhancement.

Xu et al (2019), concurred with Wang et al (2021), on Cultural and traditional practices saying some developing countries might have existing cultural and traditional practices in football training and coaching that have been effective over time. These practices might prioritize traditional methods over AI-driven approaches, leading to resistance in adopting new technologies. These traditional approaches and methods in football might be deeply ingrained in the culture of Zimbabwean football and adopting AI could be seen as a threat to the existing systems, leading to resistance from players, coaches, and other stakeholders.

Li et al (2020), sighted lack of awareness and understanding about the potential benefits of artificial intelligence in football among stakeholders in second world countries as the foundation of their resistance in adopting the use of AI in football and he suggested that education and training programs to enhance knowledge about AI could help overcome this hurdle, whereas Singh and Shukla (2018), views the resistance from most stakeholders in developing countries are hinged on fearing to lose jobs and their relevance to the adoption of AI.

Smith and Johnson (2020), hinted that prioritization of resources may be another contributing factor leading developing nations resist the adoption of AI in football as more attention will be given to areas as infrastructure development, healthcare, and education, over the adoption of artificial intelligence in football.

Santeramo, et al (2018), postulates that lack of diverse sample population is one of the limiting factor as many studies in the field of AI and biomechanical performance in football have focused on male players, while research on female players is relatively limited, whereas Smith and Johnson (2020) pointed out that research on different age groups, such as youth and veteran players, is also lacking. It is important to include a diverse sample population in order to obtain comprehensive and representative results.

Zhang, et al, (2020) and Xu, et al (2019) agrees on controversies surrounding AI implementation that there are ongoing debates and controversies regarding the implementation of AI in sports, though Lee, et al. (2019), argues that AI can provide valuable insights and enhance performance, while Chen, et al. (2020), expresses concerns regarding data privacy, ethical considerations, and potential biases in decision-making algorithms. These controversies should be taken into account when considering the use of AI in enhancing the biomechanical performance of Zimbabwean elite footballers.

The use of AI in sports raises ethical questions, such as concerns about player privacy, fairness, and a level playing field. Developing countries might be cautious in adopting AI technologies due to these ethical implications and the need to address them.

Creating biomechanical models of football players can help analyze the physical interactions within their bodies (Smith and Johnson, 2020). These models simulate how forces and movements are generated during actions like running, jumping, kicking, and tackling. Artificial intelligence can optimize these models to detect muscle imbalances, identify weak points, and suggest corrective exercises and techniques to enhance performance and reduce the risk of injuries.

It is essential to realize that the adoption of AI in sports is a dynamic process, and developing countries may gradually embrace these technologies as they overcome these challenges and recognize their potential benefits for enhancing biomechanical performance. Artificial intelligence can be used to analyze and interpret kinematic and kinetic data in sports. By processing vast quantities of data, AI algorithms can identify key patterns and provide insights into an athlete's movement mechanics, such as joint angles, joint forces, and segmental velocities.

By leveraging these key concepts, artificial intelligence can play an important role in optimizing the biomechanical performance of footballers, enhancing their skills, reducing the risk of injuries, and ultimately improving their overall performance on the field.

2.6 Conclusion

The literature showed some of the barriers to adoption of AI in football industry of developing countries like Zimbabwe and the potential benefits on the use of artificial intelligence in order to

enhance biomechanical performance analysis of elite Zimbabwean footballers was hinted. The review of literature failed to identify any studies on the use of artificial intelligence to enhance biomechanics performance of elite athletes in Zimbabwe. Most of the reviewed studies were done in Europe, Asia, North America and Australia and they focused mainly on the use of artificial intelligence on sports performance in general. The literature search failed to take note of any studies focusing on the use of artificial intelligence in Zimbabwean sports. In general trends and the nature of AI in biomechanical performance remained misunderstood and under researched.

While studies conducted in other countries have provided quite a range of significant contributions to existing literature on overcoming the resistance of the use of artificial intelligence to enhance biomechanical performance analysis of elite athletes, they cannot accurately capture the nature and use of AI to enhance biomechanical performance analysis of elite Zimbabwean footballers, owing to socio-cultural and economic differences. The need to generate knowledge which can bridge these geographical and theoretical knowledge gaps inspired the researcher to conduct this proposed study focusing on overcoming the resistance to the adoption of AI in biomechanical performance analysis of elite Zimbabwean footballers.

2.7 Summary

The second chapter reviewed the related literature. The conceptual framework, methodological review and thematic review. The next chapter is shall to focus on the research methodology.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter is going to present the methods to be used in conducting the research with specific focus on research purpose, research paradigm, approach to theory development, time horizons, primary research strategy, choosing research participants, collection of data procedures, analyzing data and presentation, validity and reliability, ethical considerations and the summary to the chapter.

3.2 Research purpose

The research purpose is interventional as it aims to develop interventions to adopt to overcome resistance on the use of AI to enhance biomechanical performance analysis.

This approach is commonly used in fields such as science to assess the impact of interventions on human performance, behavior and learning. Interventional research typically follows a structured protocol and involves randomization of participants into experimental groups to control confounding factors. It allows researchers to evaluate cause-and-effect relationships and assess the effectiveness of interventions in real-world settings.

Interventional research provides valuable insights into the effectiveness of interventions and helps inform evidence-based practices and policies. However, it often requires ethical considerations, such as making sure that participants give informed consent from and ensuring participant safety throughout the study.

3.3 Research Paradigm

The research adopted positivism research paradigm as it is expected to unearth quantifiable and measurable data through scientific methods as it involves a coordinated consequence of quantitative and qualitative research methods.

3.4 Approach to theory development

The research adopted an inductive approach to the development of theory development, meaning theories and hypothesis will be derived from collected data. Through an iterative process of data analysis, patterns and themes emerged leading to the development of interventions to overcome resistance in the adoption of AI.

3.5 Methodological Choice

The methodological choice for this research was a cross section mixed-methods approach that coordinates both quantitative and qualitative research methods. This approach allow for the collection of both numerical data and subjective data to attain an insight on developing interventions to overcome resistance in the adoption of AI.

3.6 Primary Research Strategy

The primary research strategy was mixed method as each method will complement one another. Interviews were conducted with sports administrators, coaches and sports scientists for subjective views as well as realizing their perceptions, and attitudes when it comes to adoption of AI in biomechanical performance analysis. Questionnaires were administered on athletes and coaches to attain quantitative data. Data collected was analyzed using suitable statistical tools.

3.7 Time horizons

The study based on cross sectional time horizons. As a result, it was a snap shot of the adoption of AI in biomechanical performance analysis of elite Zimbabwean footballers. There will be no attempt to track the changes in the adoption of AI to optimize biomechanical performance of Zimbabwean elite footballers' trends over time. The decision to use cross-sectional studies over longitudinal studies was greatly influenced by considerations like resource constraints and the time frames within which this study was completed. However, cross-sectional studies will not be mostly relied upon to track and explain interventions to overcome resistance in the adoption of artificial intelligence to enhance biomechanical performance analysis since will be changing over time.

3.8 Choosing research participants

3.8.1 Population

The population of this study is defined as all elite Zimbabwean footballers who are playing in the premier soccer league, national team, elite academy, club authorities involved in the administration of sport in clubs in the premier soccer league. However, it is impractical to cover all these subjects. As a result, data will be collected from a manageable sample of these subjects. The assumption is that the selected sample will provide adequate data to answer the research questions of the study.

3.8.2 Sampling Procedures

The sample entails collecting data from forty (40) participants which include elite Zimbabwean footballers, sports administrators, coaches and sports scientists, Snowball sampling will be the best method to use to trek these elite footballers. The study used referrals from initial subjects who are within easy access of the research to generate additional subjects who are playing professional football in Zimbabwe.

3.8.3 Sample size determination

The decision to include a total of 40 participants in the research was informed by Sekaran and Bougie (2020) who argue that as a rule of thumb for determining sample size; sample sizes larger than 30 and less than 500 are appropriate for most research. Out of the 40 participants, twenty five (25) are allocated to questionnaire survey. For interviews, selection of fifteen (15) participants was informed by the views of Edwards and Skinner (2009) who argue that purposive sampling studies do not aim to be statistically representative in the manner of formal probability sampling procedures. Rather, selection was mostly focused on the case's potential to produce in-depth information on the problem that is being investigated.

3.9 Data Collection Procedures

The process of collecting data was partitioned into two phases. The first phase involved a pretest and refinement of the research instruments. In the second phase of the study, questionnaires and interviews were used to collect data concurrently from the selected research subjects.

3.9.1 Pilot study

The researcher pre-tested the questionnaire and interview schedule with a few respondents. This enabled checking the validity and reliability of the questions given by the researcher. The researcher explored their interpretation to check whether the intended meaning is clear. Therefore, the pilot study was used for refining as a measuring system to improve measuring system. Basically, the purpose of the pilot study was to:

- Make sure that subjects respond in accordance with instructions.
- Uncover and decide how to handle unanticipated problems and,
- Learn how to check the adequacy of the research instruments.

The researcher interviewed five coaches in Zimbabwean elite football. Since the study was conducted using the exploratory design, structured interviews was used.

3.9.2 Main Study

In the study a questionnaire with predominantly closed questions was used to gather data from twenty five participants comprising of athletes and coaches who are not employing AI in biomechanical performance analysis of footballers in their clubs or academies. In a bid to ensure anonymity and confidentiality, the questionnaires were self-administered in order to give the respondents freedom to express their perceptions and opinions, without bias or fear, on the questions asked without influence of the researcher. As a result, the questionnaires were forwarded to the twenty five participants through email or WhatsApp on their personal accounts and were returned after ten days after completion.

The use of questionnaires in this study was informed by the views of (Neuman, 2014) who notes their cheapness and quickness in terms of administration and the absence of the interviewer bias. The use of questionnaires also enabled the collection of standardized information from all the respondents.

It was used to gather information that the researcher used to come up with quantitative data that is given by the respondents. Quantitative data is more valid and reliable and is suitable for addressing issues, problems or questions underpinning the research problem.

Large amounts of information can be gathered from a large number of respondents at the same time.

Structured interviews were also used to collect data from fifteen participants. These included coaches, sports administrators and sports scientists. Appointments were made before to the visit using WhatsApp and phone calls and the researcher sent the interview guide prior to the appointment date so that the participants could familiarize themselves with the questions they were supposed to respond to.

Once the participants gave the green light to proceed, the researcher visited the organizations and individuals to conduct the interviews. Before the beginning of the interview, the researcher ensured that the respondents completed Informed Consent forms, so as to remind the interviewees that the interview will be mainly for the purpose of research only and also that participation in it was voluntary, and they have the right to withdraw at any given time that they felt the need to do so. It also gave them assurance of confidentiality and anonymity by telling them that the data collected will be reported in a manner which maintained anonymity for them and their organizations. After this, the researcher requested to audio record the interview. In cases where the interviewee objects to their responses being recorded, the researcher resorted to jotting down the responses on a note pad.

3.10 Data Analysis and Presentation

The researcher infer data and analyzed it using quantitative and qualitative data analysis tools. The NVivo 12 Software was used to organize the data into themes. The quantitative data collected through questionnaires was analyzed using appropriate statistical tool (SPSS). Descriptive statistics, such as means, standard deviations, and frequencies, was calculated to summarize the participants' demographics and responses. Statistical tables, graphs and charts were used for data display.

3.11 Quality Assurance and Compliance

The results of the study was presented in a clear and concise manner, with appropriate tables, figures, and graphs used to illustrate the findings. The conclusions were drawn based on the analysis of both quantitative and qualitative data, and recommendations for future research was be provided. The research report was written in accordance with academic writing standards and will include proper citation and referencing of sources. The researcher ensured there is confidentiality, informed consent and anonymity for compliance.

For quality assurance, the research was based on:

- Standardization: Research strive to standardize methods and procedures to minimize variations that could introduce bias or error. This includes using consistent protocols, instruments, and data collection techniques.
- Randomization: it involves assigning participants, treatments, or conditions randomly to control or experimental groups. This helps to reduce bias and increase the chances of obtaining representative and generalizable results.
- Replication: it involves conducting the same study multiple times to evaluate consistency and confirm the findings. Replicating research helps establish its reliability and allows for identifying any potential confounding factors or errors.
- Peer review: Submitting research papers for peer review ensures that independent experts assess the quality, methodology, analysis, and interpretation of the study. Peer review provides a critical evaluation to enhance the validity and reliability of the research.
- Research design: Choosing an appropriate research design is vital for achieving valid and reliable results.
- Statistical analysis: Applying appropriate statistical techniques will help the researcher identify patterns, relationships, and significance in the data. Analyzing data rigorously minimizes the risk of drawing incorrect or unsubstantiated conclusions from the findings.

By incorporating these methods, the researcher aims to provide valid and reliable results, enhancing the integrity and trustworthiness of their research findings.

3.11.1 Validity and Reliability

Tuckman (1994:182) defines validity as, "the extent to which a test measures what it purports to measure". If the questionnaires are valid, they should come out with correct responses which measure what they are supposed to measure. In this case, the instruments are pronounced valid if they serve their purpose.

The researcher maximized validity of the two instruments by:

- refraining from using technical terms that may give confusion to the respondents.
- making sure that the questions provide alternative answers to avoid mental strain.
- avoiding vague questions that hinder the desired outcome.
- phrasing questions which will not be ambiguous and which will be arranged from simple to complex.

Frith and Macintosh (1988) define reliability as "the extent to which the same test would give the same results if it could be taken by the same respondents under the same conditions''.

Tuckman (1994) remarks that, "One way to measure reliability is to give the same people the same test on more than one occasion and then compare each person's performance on the different testing". The questionnaires will be subjected to a pilot study to test for reliability.

3.11.2 Ethical Considerations

When involving human beings, ethics must be given typical considerations. The researcher took note of issues concerning informed consent, emotional well-being, and reciprocity which researchers need to give special attention to.

The anonymity of the participants was to be protected throughout the study at all costs. Participants should maintain anonymity and as such, both the questionnaires and interviews were conducted strictly on a one-to-one basis with the researcher. The researcher also shall discard any list of names, employee numbers, identification particulars, if any, or any other personal details of the participants during the study.

The study focused on achieving the informed consent of the participants. This was achieved through written consent forms which were circulated to all the participants, with follow-up clarifications which were made where necessary. The participants were also informed about the researchers' commitment to upholding anonymity and confidentiality. The targeted participants were also informed that their participation shall be voluntary and they are free to withdraw from the study at any time that they felt the need to do so without penalty. The signed informed consent forms were kept strictly under lock and key. Above all confidentiality, informed consent and anonymity were upheld.

3.12 Chapter Summary

This chapter focused on key areas such as the research purpose, research paradigm, approach to theory development, time horizons, primary research strategy, choice of research participants, procedures used to collect data, analyzing data and presentation of data, validity and reliability and ethical considerations. The data collection instruments made use of in the study such as the questionnaires and interviews were also discussed in the chapter. The next chapter shall focus on response rate, demographic data, data presentation, data interpretation, data analysis and a discussion of the findings that came up in the study.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents and discusses the response rate, demographic data and findings linked to the research objectives.

4.2 Response rate

Table 4.1

Questionnaire response rate

Questionnaire distributed	Questionnaire completed	Response rate
25	25	100%

The researcher distributed 25 questionnaires and they all came back completed with no discarded hence making 100% response rate.

4.3 Demographic data

4.3.1 Gender respondents

Figure 4.1

Gender response

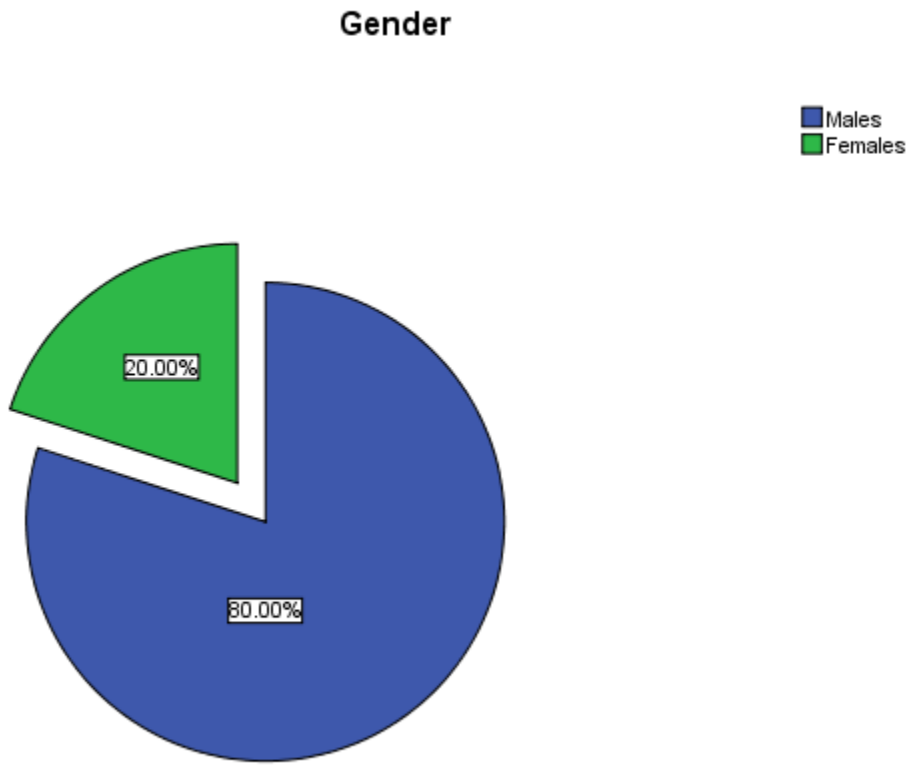


Figure 4.1 shows the gender respondents as 20 males (80%) and 5 females (20%).

4.3.2 Age respondents

Figure 4.2

Age response

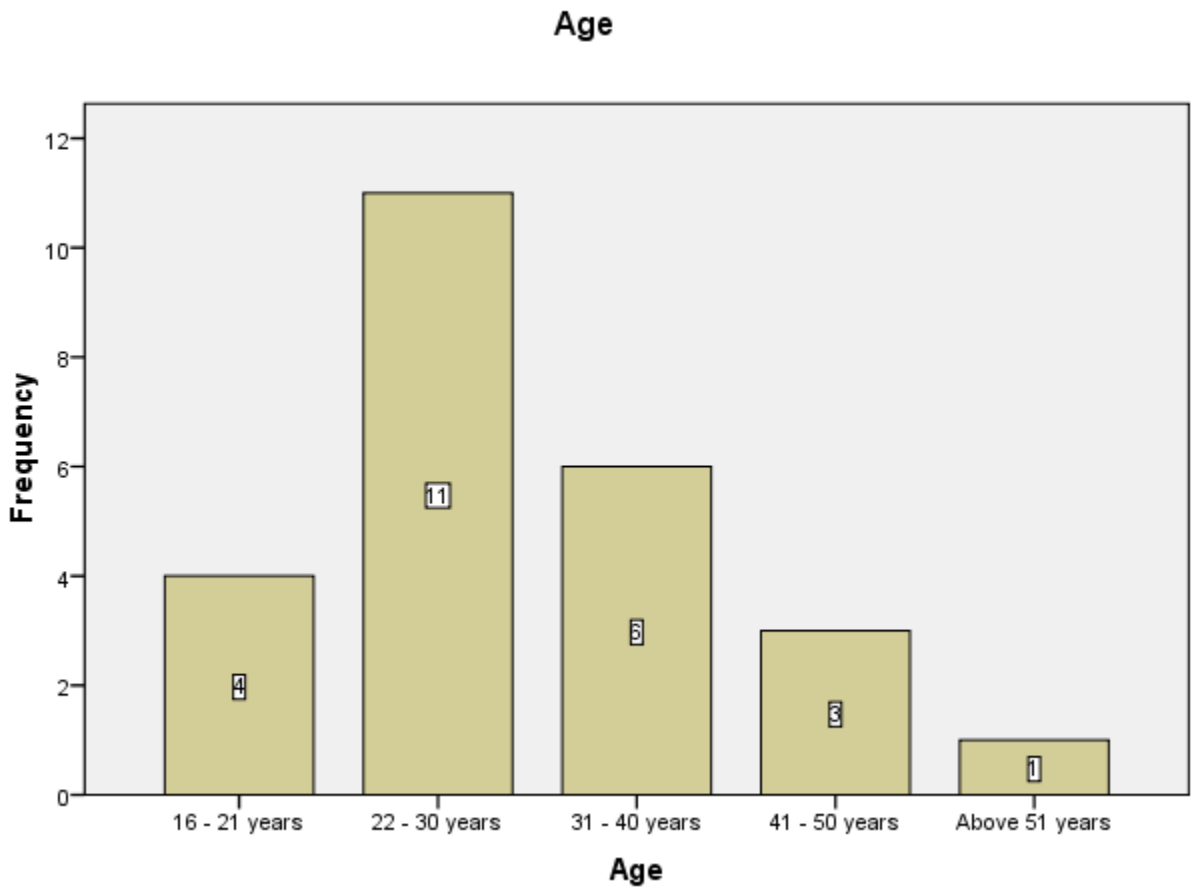


Figure 4.2 shows the age of respondents, 4(16%) of the respondents were in the range 16 to 21 years, 11 (44%) were 22-30 years, 6 (24%) were 31-40 years, 3 (12%) were 41-50 and 1(4%) were above the age of 51. This indicated that the respondents were mature enough to give proper and reliable feedback and this will lead to reliable data.

4.3.3 Marital status respondents

Figure 4.3

Marital status response

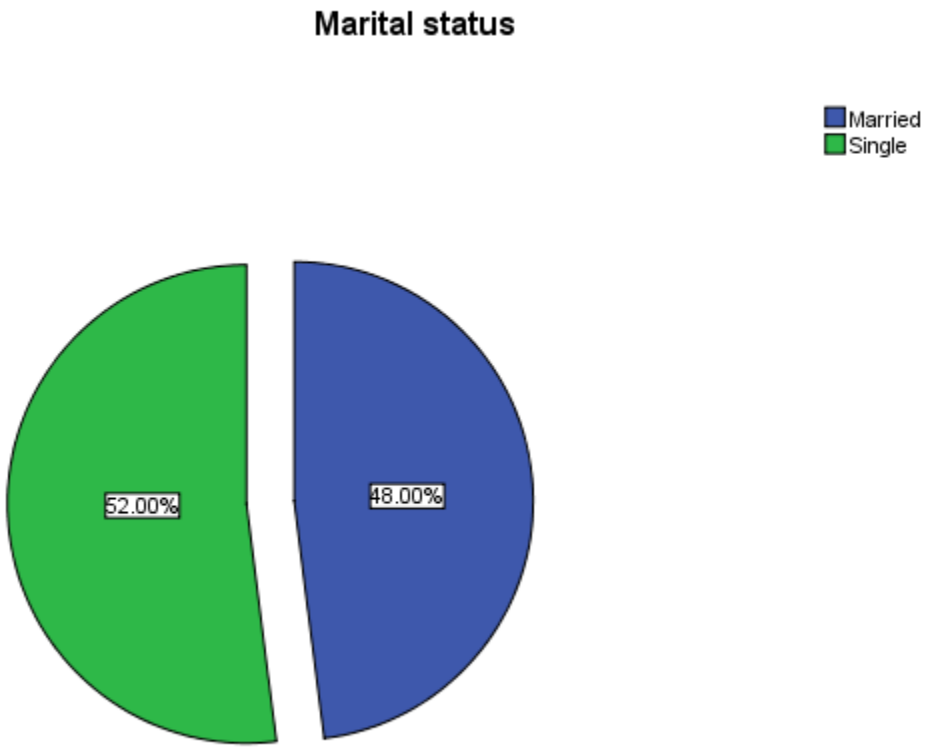


Figure 4.3, shows 13 (52%) of the respondents were married and 12 (48%) were single. The respondents were mixed that is married and single. This has a chance of obtaining data which is not biased.

4.3.4 Highest education level respondents

Figure 4.4

Highest education level response

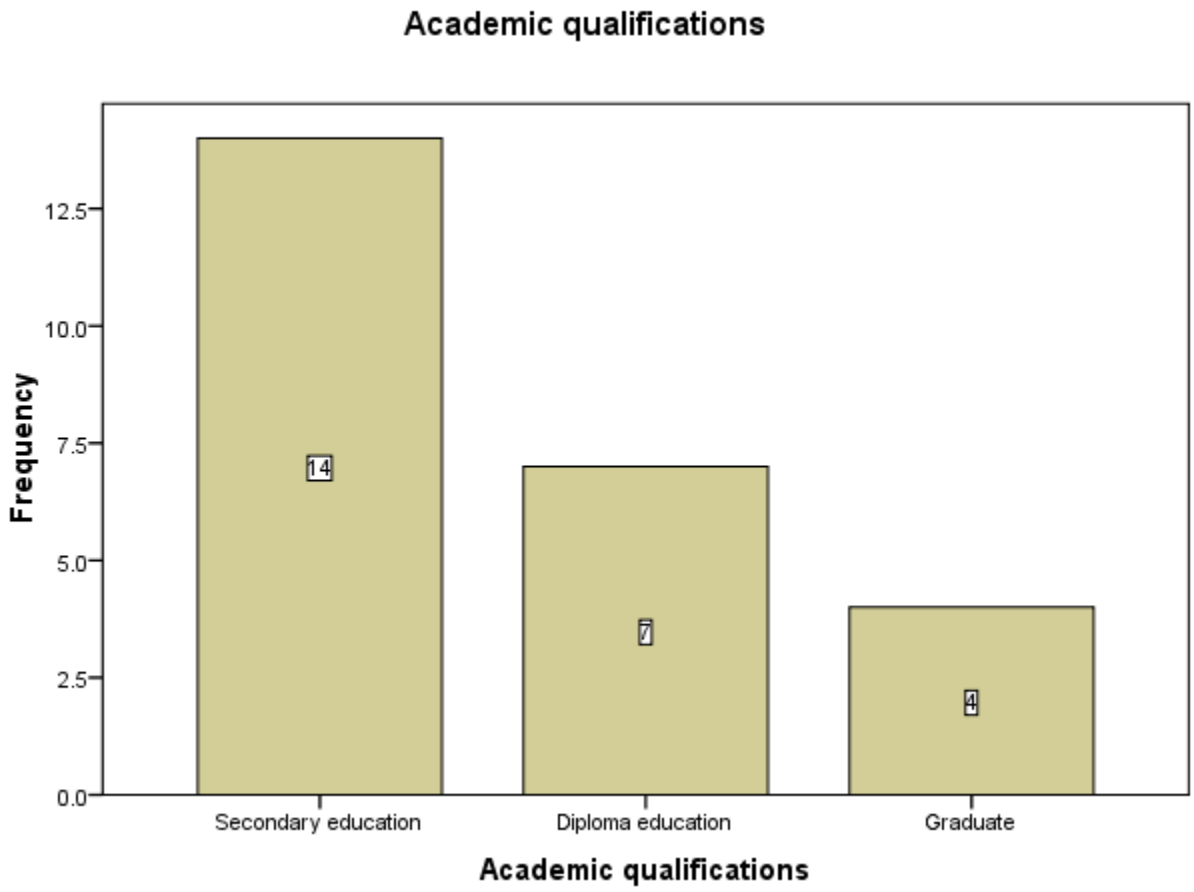


Figure 4.4 indicated that the majority of the respondents were secondary educated 14(56%), this shows that secondary education is attained by many, diploma 7(28%), the number lowers at diploma levels and lastly graduate 4(16%) the numbers continue to lower at degree level.

4.3.5 Sporting career history respondents

Figure 4.5

Sporting career history response

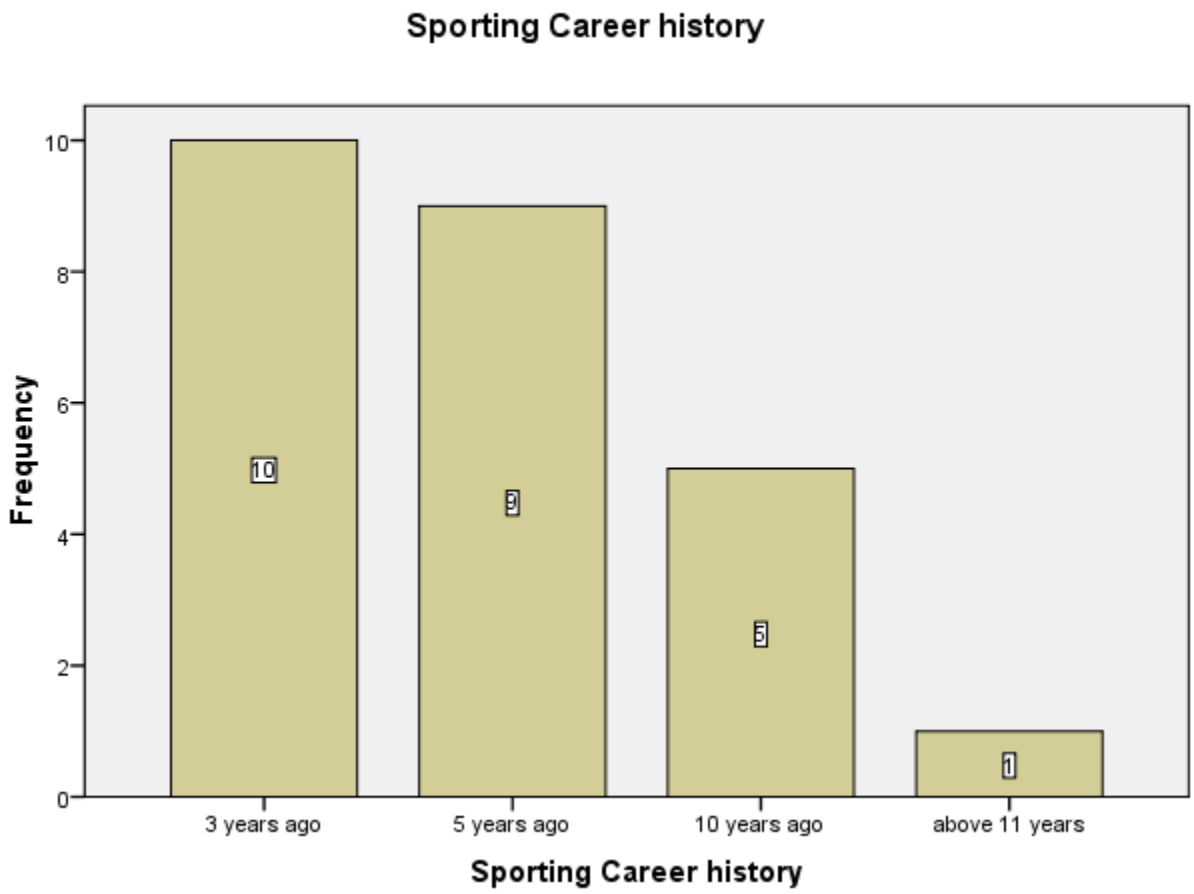


Figure 4.5 shows that there is a quite number 10 (40%) of respondents with fair experience since they have been involved in elite football for 5 years, followed by those who were involved for 3 years who set on 9 (36%), those involved for 10 years were 5 (20%) and lastly those who were there for a period of 11 years and above was also 1 (4%).

4.4 To change management related interventions

Figure 4.6

To change management related interventions response

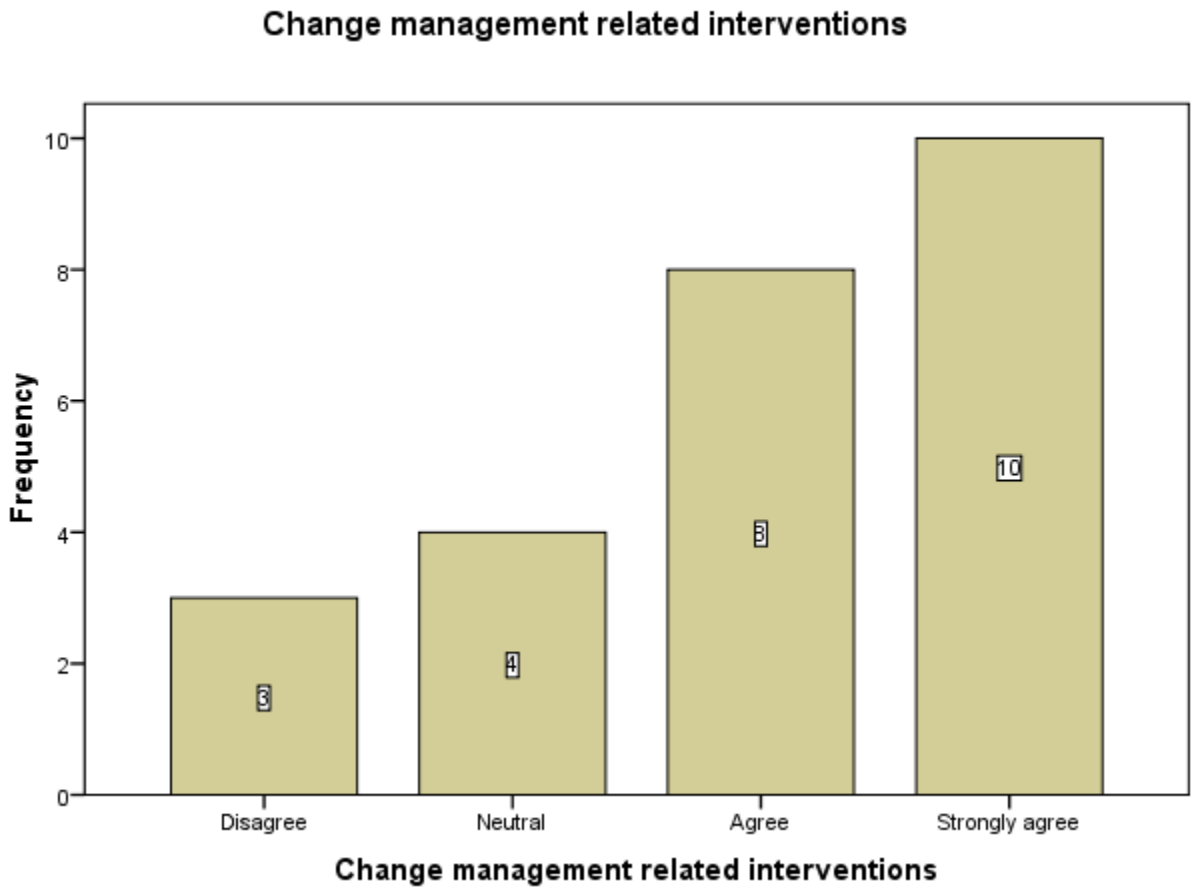


Figure 4.6 shows that 10 respondents strongly agreed, 8 agreed, 4 were neutral and 3 disagreed that management-related interventions can be changed to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers.

4.5 Using AI has benefits

Figure 4.7

Using AI has benefits response

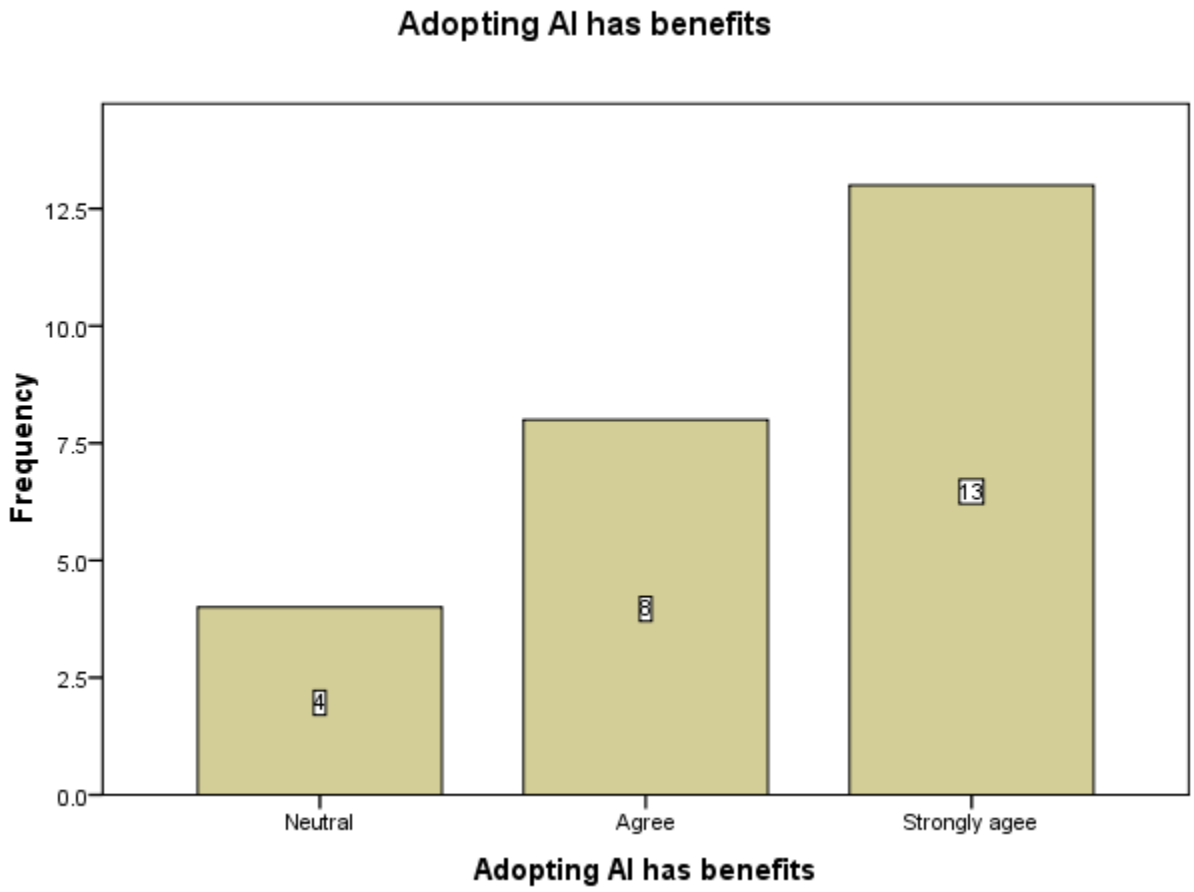


Figure 4.7 indicated that, 13 strongly agree, 8 agree and 4 were neutral on that using artificial intelligence in the biomechanical analysis of elite Zimbabwean footballers' biomechanical performance has potential benefits.

4.6 Customization of AI to suit Zimbabwean set up

Figure 4.8

Customization of AI to suit Zimbabwean set up

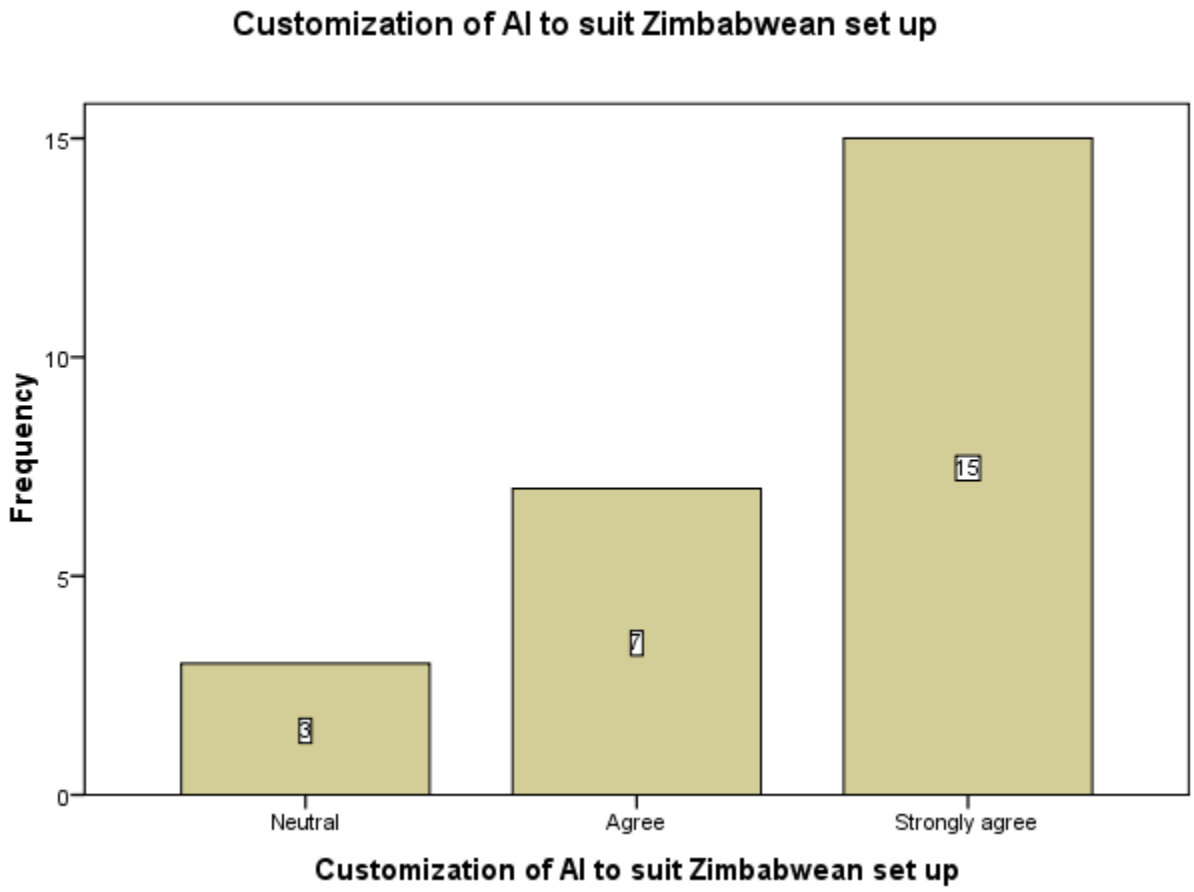
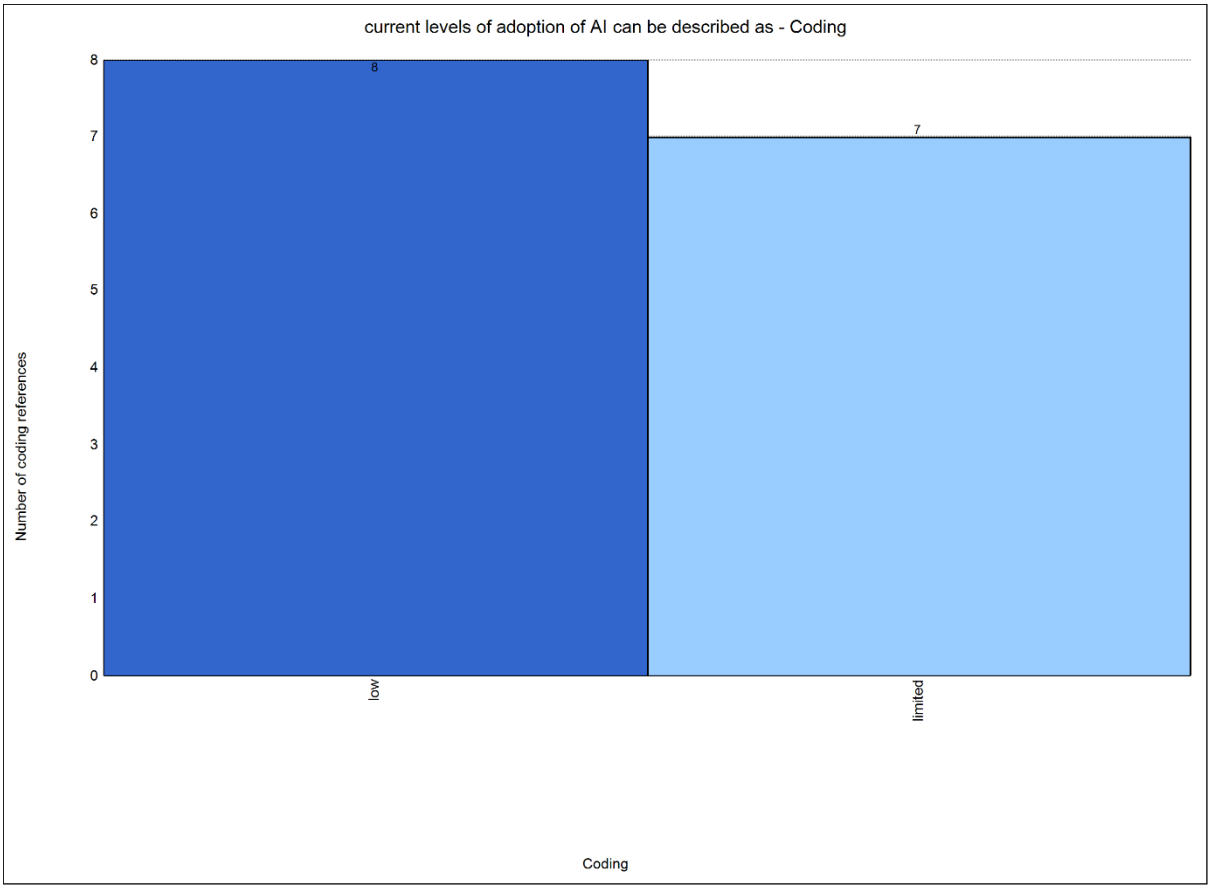


Figure 4.8 shows that 15 of the respondents strongly agree, 7 agree and 3 was neutral on the customization of Artificial intelligence systems to better suit the needs and preferences of elite Zimbabwean footballers, thus reducing resistance towards its adoption.

4.7 The current levels of adoption of artificial intelligence in Zimbabwe be described as

Figure 4.9 *the current levels of adoption of artificial intelligence in Zimbabwe be described as*



In figure 4.9 respondents 8 coding reference highlighted that the current levels of artificial intelligence adoption in the analysis of biomechanical performance of Zimbabwean footballers can be described as low and 7 coding references of the respondents pointed that it can be described as limited.

4.8 factors responsible for shaping the current adoption levels of AI in biomechanics analysis

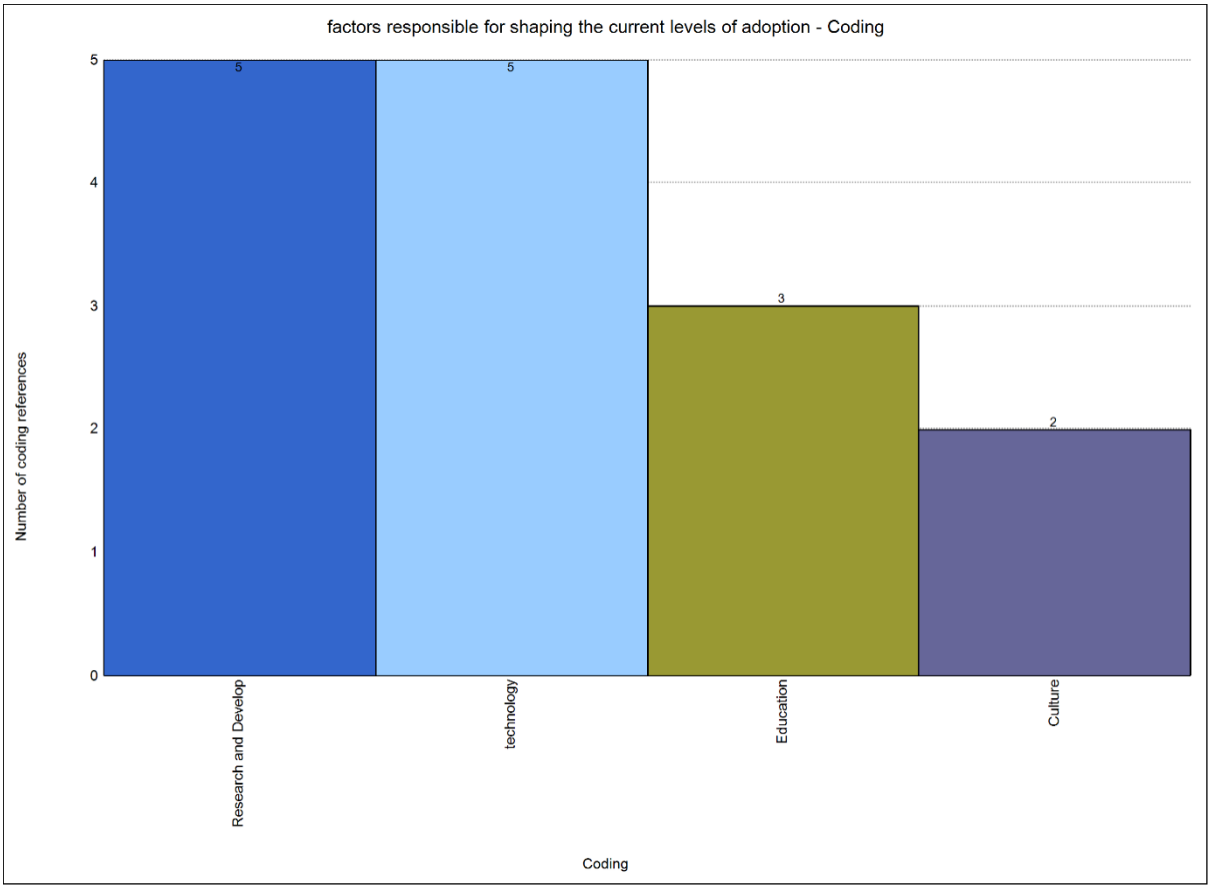


Figure 4.8

Factors responsible for shaping the current adoption levels of AI in biomechanics analysis

The current adoption levels of artificial intelligence in the analysis of biomechanical performance of Zimbabwean footballers can be influenced by various factors as shown in figure 4.10. The respondents 5 coding reference pointed on research and development, another 5 coding references set on availability of technology, followed by education awareness (3 coding reference) and lastly 2 coding reference highlighted cultural issues as factors responsible for shaping the current adoption levels. Here are some potential reasons shaping the adoption levels

4.9 Impact of the current levels of adoption of AI in the biomechanical performance analysis.

Figure 4.11

Impact of the current levels of adoption of AI in the biomechanical performance analysis.

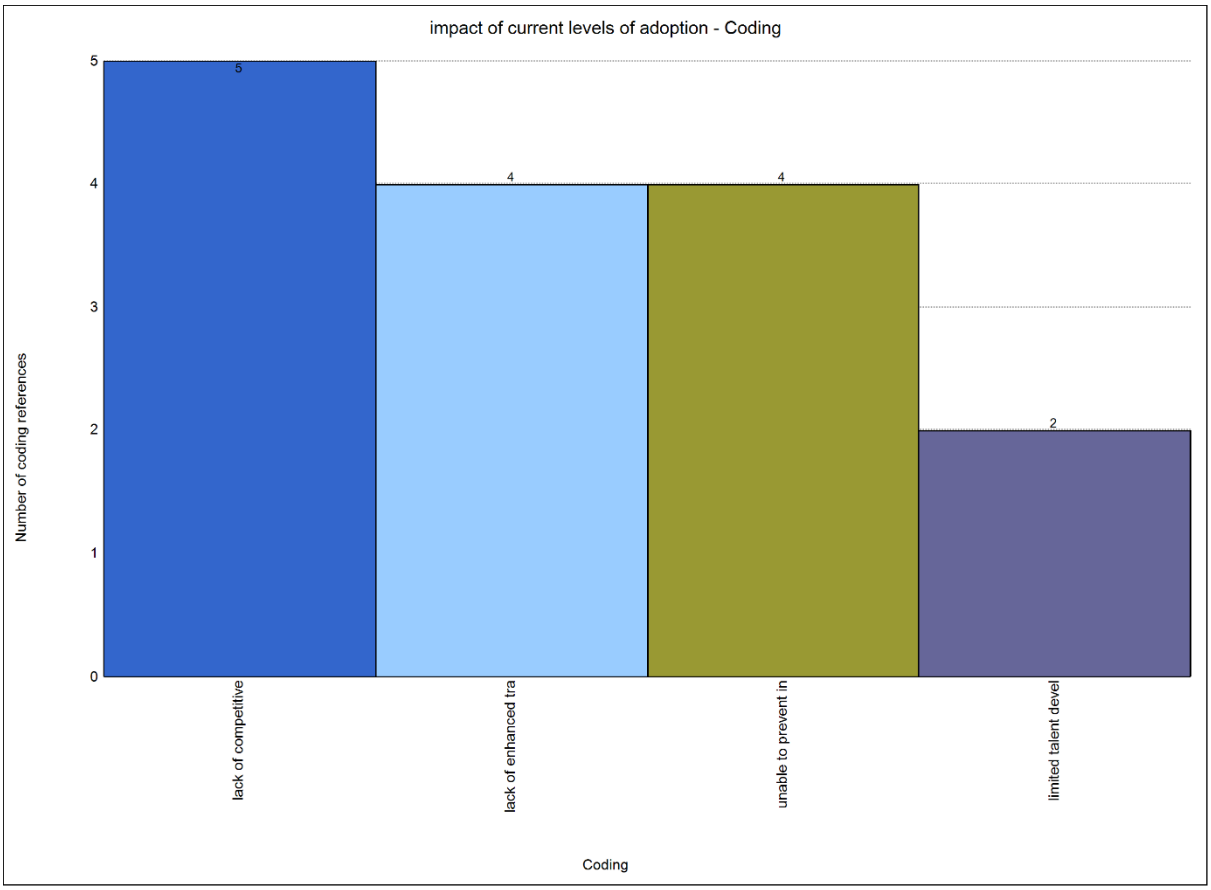


Figure 4.11 highlighted that the current levels of adoption of AI in the analysis of biomechanical performance of Zimbabwean footballers have several negative impacts. The highest number of respondents 5 coding reference pointed out that there is lack of competitive advantage, 4 coding reference pointed that lack of enhanced training program is another impact, also another 4 coding reference viewed unable to prevent injuries as another impact and lastly respondents with 2 coding reference noted that there is limited talent development.

4.10 Management - related interventions that can be developed

Figure 4.12

Management-related interventions that can be developed

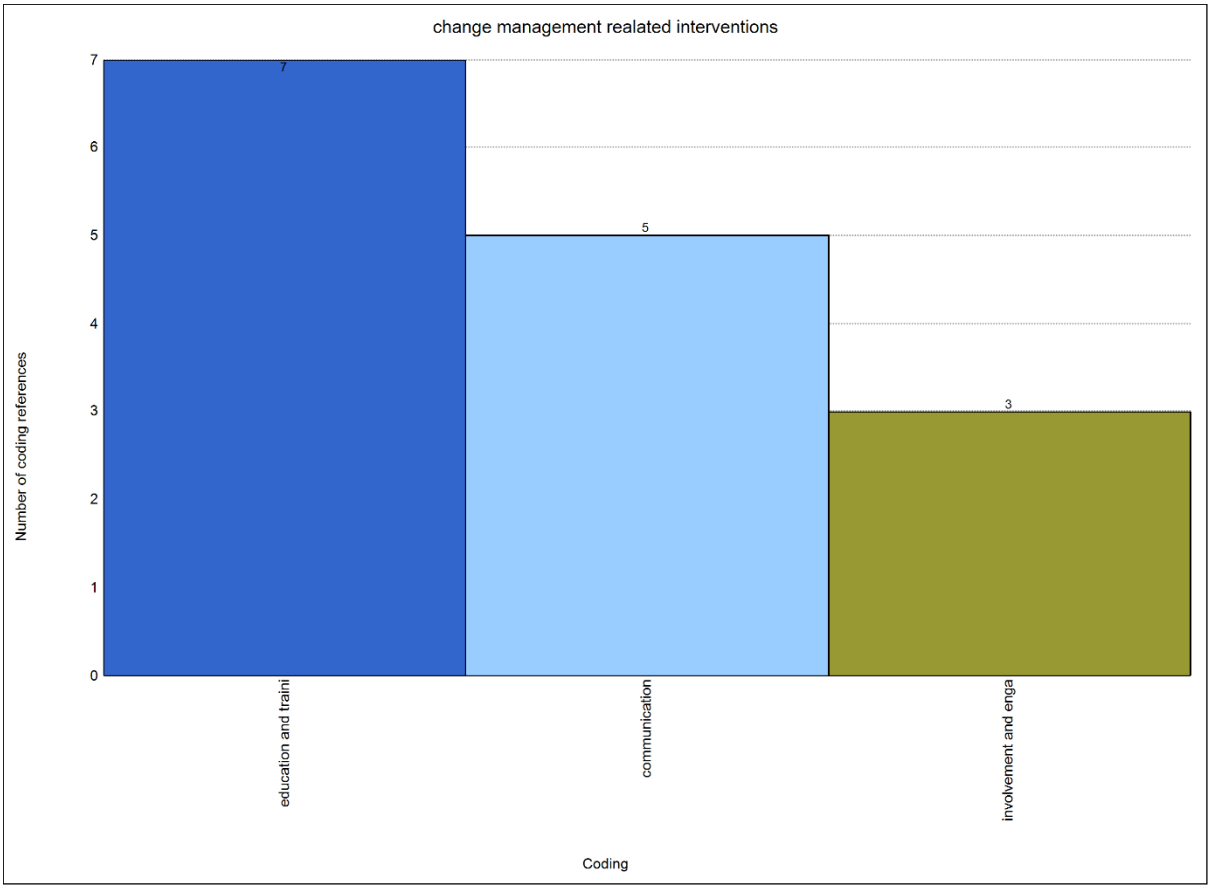


Figure 4.12 highlighted that to address resistance to the adoption of artificial intelligence in soccer, various change management interventions can be developed 7 coding references were on education and training, 3 coding references set on clear communication and 3 coding references goes for involvement and engagement.

4.4.13 Point of Convergence

In this section, the results obtained from the quantitative and qualitative data will be discussed and interpreted. On both quantitative and qualitative findings the majority of the respondents were in agreement that it is necessary to establish management related interventions that will help to overcome the resistance in the adoption of artificial intelligence in biomechanical

performance analysis of Zimbabwean footballers. Also majority of the respondents agreed through both interviews and questionnaires that adopting AI in the biomechanical performance analysis has vast benefits to players, coaches, sports scientists. Respondents were of the view that it is important to customize AI so as to suit Zimbabwean set up while overcoming the resistance of its adoption. On qualitative data it was established that education and training, pilot programs, engagement and involvement, clear communication, support and resources, incentives and recognition, being change champions and feedback mechanism are part of the management related interventions necessary to overcome the resistance to the adoption of artificial intelligence in biomechanical performance analysis of Zimbabwean footballers. Also availability of technology, research and development, awareness education, collaboration and partnerships, regulatory environment, performance improvement and cultural issues are factors responsible for shaping AI adoption levels in biomechanical performance analysis of Zimbabwean footballers. Interviews unearth the impact of the current levels of adoption of AI as failing to prevent injuries, limited talent development, lack of competitive advantage, limited performance analysis and lack of enhanced training program. Lastly the current levels of adoption of artificial intelligence was described as low or limited.

4.5 Chapter summary

This chapter presented and analyzed the data collected from the field through interviews and questionnaires. It can be noted that, from the findings, the primary data collected was a success more so given the overwhelming response. The responses were an indication that it is possible and necessary to overcome the resistance to adopt AI in the analysis of biomechanical performance. The following chapter will focus on the summary of the main areas of the topic under study and give the new, forthcoming insights coming out of the study and limitations of the study.

CHAPTER FIVE: DISCUSSIONS

5.1 Introduction

This chapter is going to discuss the research findings and give a summary and the new insights emerging from the study and the limitations of the study.

5.2 Discussion

The discussion section of this thesis aims to critically analyze the findings from the research study on developing interventions to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers. The discussion will focus on these key areas: the significance of overcoming resistance in the adoption of AI in the biomechanical analysis, the effectiveness of developed interventions in adopting AI and the implications of the study for future research and practice.

Adopting AI is a major stride in sports performance analysis as it assists in injury prevention, enhanced training programs which are tailor made to suit the individual needs of athletes. Previous researches has consistently highlighted on optimizing performance in sports through the use of AI, however there are hurdles in adopting the use of AI in performance analysis and findings has pointed that these barriers can be addressed through implementing several interventions as making sure there is education awareness, training, engagement and involvement and there should be clear lines of communication with effective feedback for soccer institution to tackle the resistance easily and establishing wide spread of embracing technology in sports.

Findings from the research study on developing interventions to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers has several implications for future research and practice. Firstly, the study highlights the impacts of resisting to adopt AI in biomechanical analysis of footballers as this is posing dangers and exposing them to injuries that might have been prevented given the chance of using high technological tools in movement analysis during training sessions and competitions. Also, it is vital to address cultural issues surrounding AI adoption in sports,

particularly football when addressing the factors shaping the current levels of adoption and this will assist when developing interventions to overcome resistance to the adoption of AI. Factors like unavailability of stable high speed internet connectivity, low research and development implementation, lack of education awareness and cultural issues are also contributing on resistance to adopt AI and was considered when designing interventions.

Furthermore, the study also points towards that AI has benefits when adopted in biomechanical performance analysis since there will be chances to unearth hidden gems during talent development, athlete profiling, performance optimization as errors will be eliminated through customized training program addressing athlete's deficiencies.

Generally, adoption of AI in Zimbabwe can be described as relatively low or limited due to a number of factors as lack of improved infrastructure, knowledgeable personnel, so there is need for education and training as an intervention. Through establishing clear lines of communication and effective feedback interventions to overcome resistance can be continuously improved to guarantee AI adoption. Additionally, future research should be longitudinal to assess the developed interventions' worthiness after a long period.

The research study on developing interventions to overcome resistance to the adoption of AI has highlighted the importance of AI in biomechanical performance analysis hence interventions have been established to overcome resistance on its adoption. By developing tailored interventions that suit Zimbabwean set up in overcoming the resistance in adopting AI in biomechanical performance of elite footballers this study has the potential to contribute to the existing knowledge base in sports performance analysis using technological tools and inform future research and practice in the field. Ultimately, the findings from this study emphasize on changing management approaches so as to overcome resistance in implementing changes and that it is not an individual effort to deal with factors that hinders adoption of AI but needs every stakeholder and the government to join hands in embracing the new.

5.3 new insights

The findings of this study shows, that there should be a larger sample so that it can be generalized to a larger population. Additionally the study of the same sort should be done from grassroots

level so that talent and development will be key and a lot of undiscovered gems will be realized through embracing technology.

5.3.1 Novel findings

Several studies have highlighted the significance of performance optimization through the use of AI in biomechanical For instance, using biomechanical performance analysis technological tools can help analyze the physical interactions within players' bodies (Smith and Johnson, 2020). These tools simulate how forces and movements are generated during actions like running, jumping, kicking, and tackling. AI can optimize these tools to detect muscle imbalances, identify weak points, and suggest corrective exercises and techniques to enhance performance and reduce the risk of injuries but mostly there was a blind eye on how to overcome resistance to the adoption of these technological tools hence the findings emphasized the need for changing management related interventions to overcome resistance so as to adopt AI in performance analysis and assist athletes realizing their full potential.

The research has shown that management strategies goes a long way in addressing factors that are currently shaping the current adoption levels of AI in performance analysis. Studies by Smith and Johnson (2020), hinted that prioritization of resources by management may be another contributing factor leading developing nations resist the adoption of AI in football as more attention will be given to areas as wages over the adoption of artificial intelligence in football and this alone is evident that management has in shaping an organization's image either positively or negatively and this has overall performance of institution. Also understanding the unique Zimbabwean set up in terms of development and technology it is important to develop interventions that best consider the nation's problems at hand offering tangible solutions.

The novel findings from this study are expected to contribute to the existing literature on interventions to overcome resistance to the adoption of AI in biomechanical performance analysis. By developing customized interventions suitable for Zimbabwe this study aims to provide practical insights and recommendations for sports stakeholders and policy makers so that there is more embracement of technology which leads to biomechanical performance optimization. The results of this study may also inform future research on adopting AI in

resource-constrained setting, highlighting the importance of customizing interventions in promoting AI adoption so that performance analysis is fully realized.

5.3.2 Conceptual model

When looking at adopting artificial intelligence in biomechanical performance analysis of footballers, a conceptual model could be formulated involving several key components:

Data Collection: This stage entails collecting data from various sources such as wearable devices, video analysis, and sensors placed on the athletes during training or games which will be used to customize training programs.

Data Preprocessing: Once the data is collected, it needs to be preprocessed to clean and prepare it for analysis. This may involve removing noise, normalization, and feature extraction.

Feature Selection: Choosing the most relevant features from the preprocessed data that will help in identifying patterns and making accurate predictions.

Model Development: Developing machine learning or deep learning models to analyze the biomechanical data. This could include techniques like regression, classification, or clustering.

Model Validation: Testing the developed models on new data to ensure they are generalizing well and providing accurate insights.

Performance Evaluation: Assessing the performance of the AI models in terms of accuracy, precision, recall, or any other relevant metrics.

Integration and Deployment: Integrating the AI models into existing biomechanical performance analysis systems and deploying them for real-time monitoring and feedback.

The practical implications of this model is that it will be possible to follow the regulatory environment expectations like data protection and also the assessment involved the use of standard procedures, theoretical implications are that this model add literature to body of knowledge that will be of helpful in overcoming resistance.

Even though the model is of importance it has its limitations as it requires experts to implement for quality results and also it can also produce results when followed consistently.

By following this conceptual model, teams and researchers can leverage artificial intelligence to enhance the analysis of biomechanical performance in footballers, leading to better insights and performance improvements. This model has short comings as it relies on highest expertise when implementing it.

5.4 Limitations of the study

Apart from the valuable insights gained from this research, numerous limitations should be acknowledged. The generalizability of this study may be limited to athletes who are elite Zimbabwean footballers only. The study included, only those who are involved in Zimbabwean elite football which may affect the transferability of the results to different provinces or other sports codes. The present study concentrated on Marondera and Harare clubs and this was necessitated by the available resources and the time frame within which the project was to be completed. Future research could benefit from larger sample sizes and longitudinal designs to address these limitations. In addition, some of the participants were reluctant to give information as they expected some form of rewards out of it.

5.5 Chapter summary

This chapter presented discussions, new sights were novel findings, conceptual model were elaborated and limitations of the study was highlighted. The next chapter is going cover ground on conclusions and implications.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter focusses on the conclusions and recommendations. The conclusions will address the research questions outlined in chapter 1. Recommendations for practice and further study are also suggested in this chapter.

6.2 Conclusions

6.2.1 How can the current levels of adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers be described?

The current levels of adoption of AI in the analysis of the biomechanical performance of the elite Zimbabwean footballers can be described as limited or relatively low as majority of elite football clubs or academies are relying on traditional methods when analyzing performance.

While AI technology has made significant progress in sports analytics globally, including the analysis of biomechanics in athletes, its adoption in specific regions like Zimbabwe may still be in the early stages. This could be due to various factors such as limited access to AI technology, resources, or expertise in implementing such advanced systems in sports performance analysis. However, as AI continues to evolve and become more accessible, there is potential for increased adoption and utilization in optimizing the biomechanical performance of Zimbabwean footballers in the future.

6.2.2 What factors are responsible for shaping the current adoption levels of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers?

Form the findings a lot factors are considered for shaping the current levels of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers as availability of technology, research and development, awareness education, collaboration and partnerships, regulatory environment and cultural factors.

Limited availability of technology as the accessibility and affordability of AI technology play a crucial role in its adoption. If the necessary tools and resources for biomechanical analysis using AI are easily available, adoption is more likely.

Slow implementation of research and development is a factor responsible for the current levels of AI adoption since the ongoing research and development in the field of sports science and AI can contribute to the adoption of AI in analyzing biomechanical performance. This includes the development of new algorithms, software, and techniques tailored to sports analytics. Limited collaboration and partnerships can be considered as one of the factors responsible for the current adoption levels of AI as collaborations between technology providers, sports organizations, research institutions, and sports teams can accelerate the adoption of AI in biomechanical analysis. Partnerships that promote knowledge sharing and technology transfer can drive adoption.

Lack of awareness and education has a contribution of the current levels of adoption of AI since the awareness of the benefits of AI in analyzing biomechanical performance and proper education on how to utilize these technologies effectively can influence adoption levels. Education programs for coaches, athletes, and sports scientists can facilitate adoption. Another factor slowing the adoption of AI is failing to comply with the regulatory environment which includes data protection laws, ethical considerations, and privacy regulations, as this has impacts on the adoption of AI in sports analytics. Compliance with regulations and ethical guidelines is essential for widespread adoption.

Cultural factors and attitudes towards technology, innovation, and data-driven decision-making is also shaping the current adoption levels of AI in sports analysis since acceptance of new technologies and willingness to adapt traditional training methods is facing resistance due to fear of the unknown and generally resistance to change is also a factor responsible for shaping the current adoption levels.

By considering these factors and addressing potential barriers, the adoption of artificial intelligence in the analysis of biomechanical performance of Zimbabwean footballers can be fostered and enhanced.

6.2.3 What impact do the current levels of adoption of artificial intelligence in the analysis of biomechanical performance have on the biomechanical performance of Zimbabwean elite footballers?

The current levels of adoption of artificial intelligence in the analysis of biomechanical performance have on the biomechanical performance of Zimbabwean elite footballers resulted in a number of negative impacts.

Lack of enhanced training programs since without AI powered analysis trainers cannot tailor training program to address specific weakness in a player's biomechanical performance, when helping them to optimize their movements and prevent injuries.

Lack of competitive advantage as teams that rely solely on traditional methods and not utilizing AI in biomechanical analysis may not have a competitive edge over those embracing technology as they can make more informed decisions on player selection, training strategies and game tactics. Also lack of improved performance analysis that is by not using AI technology coaches and sports scientists can fail to gather more precise and detailed data on the biomechanical movements of players, leading to a deeper understanding of their performance and potential areas for improvement.

Poor talent development that is by not identifying and nurturing talented players based on their biomechanical data, Zimbabwe football clubs and academies may fail to uncover hidden gems and it will be difficult for them to reach their full potential on the field of play.

Failing to prevent injuries since AI technology can help identify patterns in player's biomechanical movements that may put them at a higher risk of injury, allowing coaches to intervene early and implement preventive measures way before they can happen so by not adopting AI athletes are prone to preventable injuries.

6.2.4 What change management-related strategies can be developed to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers?

Change management-related strategies that can be developed to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers, from the findings it was education and training, pilot programs, engagement and involvement, clear communication, support and resources, incentives and recognition, change champions and feedback mechanism.

Education and Training Programs is one of the interventions as there is need to implement training sessions and workshops to educate players, coaches, and staff about the benefits of artificial intelligence in soccer. This can help in increasing awareness and acceptance. Pilot Programs is also necessary that is starting with small-scale AI implementation in certain aspects of training or performance analysis to demonstrate the positive impact before scaling up. This can help in building trust and reducing resistance.

Engagement and Involvement is another intervention necessary to overcome resistance to the adoption of AI since involving players, coaches, and other stakeholders in the decision-making process regarding AI adoption can remove resistance. Their participation and input can increase acceptance and collaboration. Support and resources can go a long way in engagement that is ensuring that adequate support, resources, and tools are provided for successful AI integration. This can include technical support, training, and troubleshooting assistance. Also incentives and recognition forms a stable base on support that is offering incentives or recognition programs to motivate individuals to embrace AI and showcase the positive outcomes it can bring to the team and individual performance. Can also identify and empower change champions within the organization who can advocate for AI adoption, address concerns, and encourage others to embrace the technology.

Clear Communication is another intervention as it is important to maintain transparent communication about the goals, processes, and benefits of using AI in soccer. Address concerns, misconceptions and provide regular updates to keep everyone informed. Feedback mechanisms

should be established to gather input, suggestions, and concerns from stakeholders regarding the adoption of AI. This feedback can help in refining strategies and addressing issues promptly.

By implementing these change management-related interventions, elite Zimbabwean football institutions can effectively overcome resistance to the adoption of artificial intelligence in soccer and facilitate a smooth transition towards leveraging AI for improved performance and outcomes.

6.3 Implications or Recommendations

In an effort to overcome the resistance to the adoption of artificial intelligence in the analysis of biomechanical performance of elite Zimbabwean footballers the following suggestions are recommended:

6.3.1 Implications for practice

6.3.1.1 Development of infrastructure

Infrastructure in the form of high speed and stable internet, and other AI technology necessary for biomechanical performance analysis should be developed in soccer facilities so as to increase the adoption of AI in biomechanical performance analysis. To reduce resistance to change sports practitioners and stakeholders should be educated on the importance of using AI in performance analysis and encourage them to be change champions in pioneering the embracement of AI.

6.3.1.2 AI information, research and development

Gathering AI-driven data on preventing injuries, improving performance, creating personalized training plans, developing talent, supporting sports financially, increasing participation, supporting athletes, and promoting leadership is crucial for assessing whether sports policies and programs are providing equal access to resources and opportunities for both men and women. Therefore, it is important to study how AI is being used in sports, especially in football, to enhance our understanding of technology in sports. The Ministry of Sport Arts and Recreation should also make sure that there are proper research, monitoring, and evaluation systems in place to achieve the goals of incorporating technology in football and all sports.

6.3.2 Implications for theory

The possible future effect of the findings in the body of knowledge is that resistance in the adoption of AI can be easily tackled since there are now interventions put in place on overcoming the resistance. Since there are no specific literature that focused on elite Zimbabwean footballers concerning the adoption of AI in the analysis of biomechanical performance this study will assist in bridging the gap in literature if published.

6.3.3 Implications for further studies

The findings of this study shows, that there should be a larger sample so that it can be generalized to a larger population. Additionally the study of the same sort should be done for other sport codes so that every sport embrace technology by adopting the use of AI. Also, there is need for another study to focus on the football grassroots as there is a saying which goes catch them young.

6.4 Chapter summary

This chapter presented the conclusions drawn from the major findings; recommendations were suggested for practice to address the resistance in the adoption of AI in biomechanical performance analysis of elite Zimbabwean footballers.

REFERENCE LIST

Araújo, D. Segal, N. A., & Stylianou, A. P. (2017). Biomechanics meets the genius of football: A state-of-the-art science book. Routledge.

Brown, S. J., Thompson, D. A., Segal, N. A., & Stylianou, A. P. (2021). Current State and Future Perspectives on the Integration of Artificial Intelligence into Human Movement Science. Frontiers in Bioengineering and Biotechnology.

Clark, R. A., Pua, Y. H., Fortin, K., Ritchie, C., Webster, K. E., & Denehy, L. (2019). Validity of the Microsoft Kinect for assessment of postural control. Gait & posture.

Chen, G., Dong, C., Takagi, T., & Li, X. (2020). Deep learning for biomechanical analysis: A review. Journal of Sport and Health Science.

Chen, Y.-C., Li, X., Lin, T., Zhang, K., & Ma, Y. (2018). Sensitive training for risk prediction of lower limb musculoskeletal injuries in football players. BMC Musculoskeletal Disorders.

Gadea-Blanco, F., Takagi, T., & Li, X. (2020). Virtual reality, augmented reality, and simulation technologies for the biomechanical rehabilitation of lower limbs: A systematic review. Sensors.

James, D., Halley, W., Stanley, M., & Lawton, T. (2020). The Application of Deep Learning in Preventing Sports Injuries: A Systematic Review. Sensors.

Johnson, M. R., Ktanaki, C., Karthikeyan, M., & Holt, J. T. (2019). A systematic review of wearable motion tracking technology in the context of rehabilitation. Journal of Neuro-Engineering and Rehabilitation.

Johnson, M. C., Irwin, G., & Francis, P. R. (2020). Reinforcement learning for classification of cycling manoeuvres using inertial measurement unit data. Journal of Sports Sciences.

Lee, J. B., Karthikeyan, M., & Holt, J. T. (2019). A wearable IMU sensor system for monitoring and analyzing quasi-static and dynamic human motions. Sensors.

APPENDICIES

APPENDIX I: QUESTIONNAIRE

QUESTIONNAIRE

Introduction

My name is Chokwenda Calvin a student of the Bindura University doing MScSS. I am carrying out a research study on the topic "Developing Interventions to Overcome Resistance to the Adoption of Artificial Intelligence in the Analysis of the Biomechanical Performance of Elite Zimbabwean Footballers." You have been selected randomly to take part in this study. Could you please assist by completing this questionnaire? Your responses will be kept in strict confidentiality and will be used for the purpose of this study only. I kindly ask you to spare some time to complete this questionnaire. It will only take a few minutes. All the responses provided will be treated with strict confidentiality and shall only be used for the purpose of this study. Participation in this survey is voluntary.

Instructions:

a) Read and understand the information on all sections carefully.

b) Be as honest as possible when giving your responses.

c) For enquires please don't hesitate I will be at your disposal.

d) Tick in the correct box.

e) Do not write your name on this questionnaire.

1. Gender

- ☐ Male
- ☐ Female

2. Age

- ☐ 16 to 20
- ☐ 21 to 25
- ☐ 26 to 30
- ☐ 31 to 35
- ☐ 36 to 40
- ☐ 41 to 45
- ☐ 46 to 50
- ☐ 51 and above

3. Marital status

- ☐ married
- ☐ single
- ☐ divorced
- ☐ widow

4. Sporting Career history

3 years ago	5 years ago	10 years ago	11 + years

5. Indicate the extent to which you agree with the following statements by ticking in the appropriate box

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Change management-related interventions can be developed to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers.					
Using artificial intelligence in the biomechanical analysis of elite Zimbabwean footballers' performance has potential benefits					

APPENDIX II: INTERVIEW GUIDE

INTERVIEW GUIDE

Introduction

My name is Chokwenda Calvin a student of the Bindura University doing MScSS. I am carrying out a research study on the topic "Developing Interventions to Overcome Resistance to the Adoption of Artificial Intelligence in the Analysis of the Biomechanical Performance of Elite Zimbabwean Footballers." You have been selected randomly to take part in this study. Could you please assist by completing this questionnaire? Your responses will be kept in strict confidentiality and will be used for the purpose of this study only. I kindly ask you to spare some time to complete this questionnaire. It will only take a few minutes. All the responses provided will be treated with strict confidentiality and shall only be used for the purpose of this study. Participation in this survey is voluntary.

Instructions:

Codes will be used to identify each participant. During the interviews, you are not allowed to identify yourselves by name, by position held or your organization. When participating do not use personal information or examples that can identify you and other persons present here or not part of the discussion. The deliberations will be recorded and transcribed later.

Questions

1. How can the current levels of adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers be described?

2. What factors are responsible for shaping the current adoption levels of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers?

3. What impact do the current levels of adoption of artificial intelligence in the analysis of biomechanical performance have on the biomechanical performance of Zimbabwean elite footballers?

4. What change management-related interventions can be developed to overcome resistance to the adoption of artificial intelligence in the analysis of the biomechanical performance of elite Zimbabwean footballers?

APPENDIX III: CONSENT FORM

Principal Investigator: Chokwenda Calvin

Phone: 0774 706 316

E-mail: calvinechoc@gmail.com

Supervisor: Dr Khumalo

CONSENT

1. Upon signing this consent form, I agree to take part in the research conducted by MSc2429 and any other persons assisting or associated with the study.

2. By participating in this study, I understand the importance of being as honest as possible in all responses to the questions.

3. I understand that my participation in this project is voluntary and I may refuse participation at any time throughout the survey process.

4. I realize the results of this study could be published, but I understand that I will not be identified individually in any such population.

5. If there is a question I feel strongly about not completing, I understand I have the right to leave it unanswered.

Participant Name……Signature ……Date……

Witness Signature ……..

APPENDIX IV: ACCESS LETTER

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

P. Bag 1020

BINDURA, Zimbabwe

Tel:

+263662106134/0772916712

info@buse.ac.zw

DEPARTMENT OF SPORTS SCIENCE

TO WHOM IT MAY CONCERN.

RE: POSTGRADUATE DISSERTATION STUDY ACCESS REQUEST.

This is to certify that Chokwenda Calvin **is** a bonafide Master of Science in Sports Science student in the Department of Sports Science at the Bindura University of Science Education. He is conducting an action research study entitled:

"Developing Interventions to Overcome Resistance to the Adoption of Artificial Intelligence in the Analysis of the Biomechanical Performance of Elite Zimbabwean Footballers."

We are kindly requesting your organization to partner with him in the study by participating in the data collection and intervention strategy development process.

Participation in this research is completely voluntary and you may choose to withdraw from the research at any time. The information from your organization will only be used for academic purposes and be kept private and confidential. Codes will be used to identify participant organizations. This is meant to ensure that information would not be linked to the providers. Password-protected computers will be used to store any identifiable information that may be

obtained from your organization. Data will also be analyzed at the group level, to ensure anonymity. You can also sign confidentiality agreements with the researcher.

A copy of the finished work will be provided to your organization after the study. The results of the study are expected to transform practice and your support will be pivotal to its success.

If you have any queries regarding this project, please phone me on 0772916712, or lysiastapiwacharumbira1968@gmail.com or lcharumbira@buse.ac.zw

We would like to thank you in advance for your support.

Yours Sincerely

Lysias Tapiwanashe Charumbira (Dr.)

Chairperson