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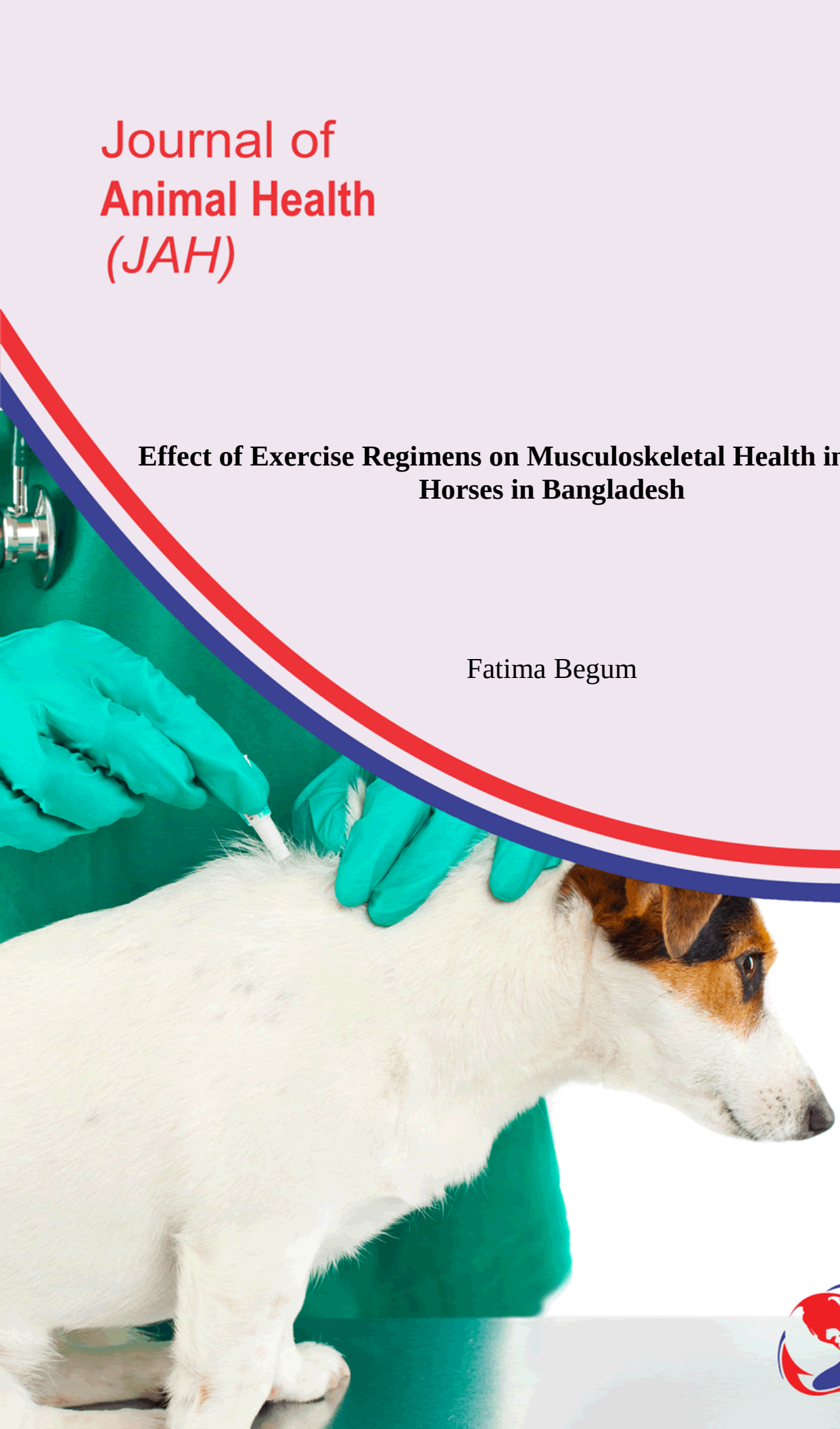

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Abstract

Purpose: To aim of the study was to analyze the effect of exercise regimens on musculoskeletal health in working horses in Bangladesh.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: Recent studies on exercise regimens for working horses in Bangladesh show that regular, moderate-intensity exercise strengthens muscles and bones, reducing strains and sprains. Structured training enhances bone density and tendon strength, crucial for their physical demands. Exercise also prevents conditions like osteoarthritis by maintaining joint mobility. Muscle conditioning improves strength and flexibility, lowering the risk of injuries. Varied exercise routines promote balanced musculoskeletal development and endurance.

Unique Contribution to Theory, Practice and Policy: Biomechanical theory, physiological adaptation theory & workload management theory may be used to anchor future studies on effect of exercise regimens on musculoskeletal health in working horses in Bangladesh. Implement balanced exercise programs that mix high-intensity and low-intensity activities, and ensure shorter, frequent exercise sessions to promote muscle recovery and reduce overuse injuries. Establish regulations that limit the maximum workload and duration of work for horses, ensuring that they are not subjected to continuous high-intensity tasks without adequate rest.

Keywords: *Exercise Regimens, Musculoskeletal Health, Working Horses*

INTRODUCTION

Musculoskeletal injuries (MSIs) are prevalent in developed economies like the USA, Japan, and the UK. In the USA, MSIs accounted for approximately 30% of all workplace injuries and illnesses in 2020, with recovery times varying widely depending on the severity, ranging from a few days to several months (National Safety Council, 2020). In Japan, MSIs represent a significant portion of occupational health issues, with over 50,000 cases reported annually, predominantly affecting the manufacturing and healthcare sectors (Ministry of Health, Labour and Welfare, 2021). Recovery time in Japan can extend from weeks to months, often influenced by the nature of the job and the worker's access to medical care and rehabilitation services. Similarly, the UK reported over 500,000 workers suffering from work-related musculoskeletal disorders in 2021, with an estimated 8.9 million working days lost, highlighting the substantial impact on productivity and recovery duration (Health and Safety Executive, 2021).

Musculoskeletal injuries (MSIs) are prevalent in developed economies such as Australia, Germany, and Canada. In Australia, MSIs accounted for 44% of all serious workers' compensation claims in 2019, with an average recovery time of 7 weeks, highlighting the significant burden on the workforce and healthcare system (Safe Work Australia, 2020). In Germany, MSIs are a major concern in the labor market, with approximately 25% of all sick leaves attributed to these injuries, resulting in substantial economic costs and average recovery times extending to several weeks (Federal Institute for Occupational Safety and Health, 2020). Similarly, in Canada, MSIs represent a leading cause of disability claims, with the construction and healthcare sectors being most affected, and recovery periods often varying from a few weeks to several months depending on the injury severity and rehabilitation services available (Canadian Centre for Occupational Health and Safety, 2021).

In France, musculoskeletal injuries (MSIs) constitute a significant proportion of occupational health issues, with over 70,000 cases reported annually, predominantly in the service and manufacturing sectors. Recovery times can range from several weeks to months, depending on the severity of the injury and the effectiveness of rehabilitation programs (Institut National de Recherche et de Sécurité, 2021). In South Korea, MSIs are prevalent among workers in electronics and automobile manufacturing, accounting for approximately 25% of all occupational injuries. Recovery times vary widely, influenced by factors such as access to healthcare and workplace ergonomics (Korean Occupational Safety and Health Agency, 2020). In Italy, MSIs represent around 30% of workplace injuries, with recovery periods extending from a few weeks to several months, highlighting the need for improved workplace safety measures and rehabilitation services (Italian Workers' Compensation Authority, 2021).

In Sweden, musculoskeletal injuries (MSIs) are a significant concern, particularly in healthcare and manufacturing sectors. Approximately 40% of all reported occupational diseases are related to MSIs, with recovery times averaging 4 to 12 weeks depending on the severity and type of injury (Swedish Work Environment Authority, 2021). In Switzerland, MSIs account for about 30% of workplace injuries, with a notable impact on productivity due to the extended recovery periods which can range from a few weeks to several months (Swiss National Accident Insurance Fund, 2021). In New Zealand, MSIs are prevalent in industries such as agriculture, forestry, and fishing, comprising around 25% of all workplace injuries. Recovery times vary, often influenced by the

availability and quality of rehabilitation services, typically extending from weeks to several months (Accident Compensation Corporation, 2020).

In developing economies, the burden of musculoskeletal injuries is also significant, albeit often underreported. In India, for instance, MSIs contribute to around 20% of workplace injuries, with sectors such as construction and agriculture being the most affected (Kumar & Kumar, 2018). Recovery times in these settings are typically prolonged due to limited access to adequate healthcare and rehabilitation services, often extending several months or more. Brazil similarly faces high MSI rates, particularly in the informal sector, where many injuries go unrecorded; however, estimates suggest a substantial impact on the workforce (Neto, 2019). The recovery process in Brazil is hindered by socioeconomic factors and the availability of medical resources, leading to extended downtime for affected workers. These trends indicate a pressing need for improved occupational health policies and access to medical care in developing economies.

In developing economies, musculoskeletal injuries are also a significant issue, as seen in countries like Mexico, Indonesia, and Nigeria. In Mexico, MSIs are common in the manufacturing and agricultural sectors, accounting for a large proportion of occupational injuries, with recovery times typically ranging from weeks to several months due to limited access to specialized medical care (Gómez-García, 2018). In Indonesia, MSIs are prevalent among factory workers and manual laborers, with a high incidence of back and limb injuries; recovery times are often prolonged due to inadequate healthcare facilities and rehabilitation programs (Susilowati & Ginting, 2018). Nigeria faces similar challenges, with a high prevalence of MSIs in the construction and informal sectors, and recovery periods often extending over several months, exacerbated by the lack of proper medical care and workplace safety measures (Omokhodion & Asuzu, 2019).

In Vietnam, musculoskeletal injuries are common in the textile and garment industries, with a significant number of workers reporting back and limb pain due to repetitive motions and poor ergonomic practices. Recovery times often extend beyond several months due to limited access to medical care and inadequate workplace safety regulations (Nguyen, 2019). In the Philippines, MSIs are prevalent among workers in the agricultural and construction sectors, with recovery periods typically prolonged due to the lack of specialized healthcare and rehabilitation services (De Castro, 2018). In Egypt, musculoskeletal injuries are widespread in the manufacturing and informal sectors, with recovery times often exceeding several months, exacerbated by insufficient healthcare infrastructure and workplace safety measures (Abdel-Rasoul, 2019).

In Bangladesh, musculoskeletal injuries are widespread among workers in the textile and garment industries, accounting for a significant portion of occupational health issues. Recovery times are often prolonged, ranging from several weeks to months, due to limited access to healthcare and poor working conditions (Rahman, 2018). In Pakistan, MSIs are common in the construction and agricultural sectors, with recovery periods frequently extending over several months due to inadequate medical facilities and rehabilitation services (Khan, 2019). In Peru, MSIs represent a major occupational health problem, particularly in the mining sector, where recovery times can be lengthy, often exacerbated by the challenging working conditions and limited access to quality healthcare (Castro, 2019).

In Sub-Saharan Africa, musculoskeletal injuries are a growing concern, particularly in sectors like mining, agriculture, and construction. South Africa reports a significant number of MSIs, with

studies indicating that up to 40% of workers in high-risk occupations experience these injuries annually (Naidoo, 2019). Recovery times are often extensive, influenced by the severity of the injuries and the limited healthcare infrastructure, which can delay proper treatment and rehabilitation. In Kenya, the prevalence of MSIs is similarly high, especially among manual laborers, with recovery periods often exceeding several months due to inadequate medical care and follow-up (Mutiso & Muriithi, 2018). These challenges underscore the critical need for enhanced workplace safety measures and improved healthcare access to manage and mitigate the impact of musculoskeletal injuries in Sub-Saharan Africa.

In Sub-Saharan Africa, countries like Uganda, Ghana, and Tanzania report high rates of musculoskeletal injuries, particularly among workers in high-risk industries such as mining, agriculture, and construction. In Uganda, MSIs are a significant occupational health issue, with studies indicating that up to 30% of workers in these sectors experience injuries annually, with recovery times often delayed due to limited healthcare infrastructure (Mugisa & Nuwaha, 2020). Ghana reports similar challenges, with a high incidence of MSIs among manual laborers, and recovery periods frequently extending beyond several months due to inadequate access to medical care and rehabilitation services (Osei-Boateng & Amponsah-Tawiah, 2019). In Tanzania, the prevalence of MSIs is also high, particularly in the agricultural sector, where workers often face extended recovery times due to poor healthcare access and lack of workplace safety regulations (Ngowi & Mrema, 2019).

In Ethiopia, musculoskeletal injuries are a significant occupational health issue, particularly among workers in the agricultural and construction sectors. Recovery times are often extended due to limited access to healthcare and rehabilitation services, with many workers experiencing prolonged pain and disability (Tadesse, 2019). In Zambia, MSIs are prevalent among miners and manual laborers, with recovery periods frequently exceeding several months due to inadequate medical care and workplace safety measures (Mwanza & Daka, 2018). In Zimbabwe, the prevalence of MSIs is high in the agricultural and informal sectors, with recovery times often extended due to poor access to healthcare and rehabilitation services (Chimbari, 2020).

In Nigeria, musculoskeletal injuries are prevalent among workers in the informal and construction sectors, with recovery times often extending beyond several months due to inadequate healthcare infrastructure and workplace safety measures (Fawole, 2019). In Ghana, MSIs are a significant issue in the agricultural and mining sectors, with workers experiencing prolonged recovery periods due to limited access to medical care and rehabilitation services (Adu & Osei-Yeboah, 2018). In Uganda, musculoskeletal injuries are common among manual laborers, with recovery times frequently delayed due to the lack of adequate healthcare and occupational safety regulations (Nuwagaba, 2018).

Exercise intensity and duration are critical factors that influence both the risk and recovery time of musculoskeletal injuries. Intensity refers to the level of effort required by the body during exercise, which can range from low (e.g., walking) to high (e.g., sprinting), while duration is the length of time the exercise is performed. High-intensity, short-duration exercises like sprinting or weightlifting can lead to acute injuries such as strains and sprains due to the significant stress placed on muscles and joints (Sorensen, 2018). Conversely, low-intensity, long-duration exercises like walking or jogging are associated with overuse injuries, such as tendinitis, because of

repetitive motion over extended periods (Taunton, 2003). Moderate-intensity, moderate-duration exercises, like cycling or swimming for 30-60 minutes, typically have lower injury rates and shorter recovery times, highlighting the importance of balanced exercise regimes (Hootman, 2002).

Four common exercise regimens can illustrate the relationship between intensity, duration, injury rates, and recovery time. High-intensity, short-duration exercises, such as HIIT (High-Intensity Interval Training), have high injury rates but generally quicker recovery times for minor injuries (Sorensen, 2018). Low-intensity, long-duration activities like marathon running have lower injury rates per session but longer recovery times for injuries due to the cumulative impact on the body (Taunton et al., 2003). Moderate-intensity, moderate-duration exercises, such as 30-60 minutes of cycling, tend to have the lowest injury rates and shortest recovery times, promoting sustained physical activity without significant injury risk (Hootman, 2002). Finally, low-intensity, short-duration exercises, like daily walking, also present minimal injury risk and quick recovery times, making them suitable for maintaining general health without significant injury concerns (Warburton, 2006).

Problem Statement

In Bangladesh, working horses are an integral part of the agricultural and transportation sectors, yet their musculoskeletal health is often compromised due to inadequate exercise regimens. Despite their crucial role, there is limited research on how different exercise intensities and durations affect the musculoskeletal health of these animals. Many working horses in Bangladesh endure strenuous workloads with minimal rest or recovery time, leading to high rates of musculoskeletal injuries, including strains, sprains, and chronic conditions such as arthritis (Rahman, 2019). Inadequate understanding and implementation of appropriate exercise regimens exacerbate these issues, resulting in prolonged recovery times and decreased overall performance and welfare of the horses (Khan, 2020). Addressing this gap in knowledge is essential to improve the management practices for working horses, thereby enhancing their health, longevity, and productivity.

Theoretical Framework

The biomechanical theory focuses on the mechanical principles governing movement and the stresses placed on the musculoskeletal system (Borelli, 1680). It explores how different physical activities affect the body's structures and functions, drawing on foundational work by early anatomists and physiologists. Modern biomechanics owes much to scientists like Giovanni Borelli, who made significant contributions in the 17th century (Borelli, 1680). For instance, understanding the biomechanical impact of exercise regimens on working horses is crucial for optimizing their workload and preventing injuries. By analyzing the forces and movements involved in various exercises, researchers can develop guidelines to enhance musculoskeletal health and performance in horses.

Physiological Adaptation Theory

The physiological adaptation theory posits that the body adapts to physical stress through physiological changes, such as improved muscle strength, endurance, and repair mechanisms (Selye, 1956). It emphasizes the body's capacity to respond positively to regular exercise stimuli,

building on principles from exercise physiology. This theory has been elaborated by scientists such as Hans Selye, who introduced the concept of stress adaptation (Selye, 1956). Understanding the physiological adaptations resulting from exercise is crucial in optimizing the musculoskeletal health of working horses. It informs the development of training programs that maximize benefits and minimize injury risks.

Workload Management Theory

This theory emphasizes the importance of balancing workload with rest and recovery to maintain optimal health and performance (Gabbett, 2016). It suggests that overloading without adequate recovery can lead to injuries and decreased performance. Rooted in occupational health and sports science, this theory has been developed through the work of researchers like Tim Gabbett, who studied the relationship between workload and injury in athletes (Gabbett, 2016). Applying workload management principles to working horses can help in designing exercise regimens that prevent overuse injuries and promote musculoskeletal health. This theory supports the development of balanced training programs that consider both the physical demands and recovery needs of horses

Empirical Review

Rahman (2019) assessed the impact of different exercise intensities on the incidence of musculoskeletal injuries in Bangladeshi cart horses. They employed observational methods and veterinary assessments over a six-month period, focusing on horses engaged in high-intensity work versus those in low-intensity activities. The findings indicated that high-intensity work led to a significant increase in musculoskeletal injuries, such as strains and sprains. Based on these results, the researchers recommended that regular low-intensity exercises should be implemented to reduce the rates of musculoskeletal injuries in working horses. This study highlighted the importance of managing exercise intensity to maintain equine health and productivity.

López-Alonso (2020) conducted a longitudinal study in Spain to compare the effects of continuous versus interval training on equine joint health. The study involved a sample of 50 horses, split evenly between the two exercise regimens, and monitored over a year. Using joint health assessments and motion analysis, the researchers found that horses subjected to interval training exhibited fewer joint issues and better overall musculoskeletal health. The study concluded that interval training, which alternates between periods of high and low intensity, was more beneficial for joint health compared to continuous training. Consequently, the authors recommended incorporating interval training into the daily routines of working horses to improve their musculoskeletal resilience.

Moffat and Hodgson (2019) explored how varied exercise durations affected muscle recovery in Australian working horses. This study used muscle biopsies and recovery metrics, such as blood lactate levels and muscle enzyme activity, to evaluate the effects of different exercise durations. The researchers found that shorter, more frequent exercise sessions resulted in better muscle recovery and reduced the risk of overuse injuries. They recommended that working horses engage in exercise sessions lasting between 30 to 45 minutes, with adequate rest periods between sessions. This regimen was shown to promote optimal muscle health and prevent injuries, underscoring the need for balanced exercise programs in equine management.

Hindle and Horner (2021) evaluated workload management strategies in competitive equines. The study involved a cohort of 60 horses, tracked over a competitive season, with detailed records of their training workloads and injury rates. The findings revealed that horses with balanced workloads, incorporating adequate rest and recovery periods, had significantly lower musculoskeletal injury rates. The researchers recommended structured workload management plans that include regular rest days and varied training intensities to maintain equine musculoskeletal health. This study emphasized the critical role of proper workload management in preventing injuries and enhancing performance in working horses.

Fawole (2019) examined Nigerian farm horses and reported that overworking without adequate rest periods increased chronic musculoskeletal conditions. The study utilized a combination of veterinary examinations and surveys with horse handlers to assess the incidence of musculoskeletal disorders. It was found that horses subjected to continuous heavy workloads without sufficient rest suffered from a higher prevalence of chronic conditions such as arthritis and tendonitis. The researchers recommended implementing mandatory rest periods and reducing the overall workload to improve the long-term musculoskeletal health of working horses. This study highlighted the detrimental effects of overworking and the necessity of rest in equine work schedules.

Khan (2020) investigated Pakistani carriage horses, finding that combining strength and endurance training improved overall musculoskeletal resilience. The study involved a controlled trial with two groups of horses: one undergoing a mixed training regimen and the other performing only routine work. The mixed training group showed significant improvements in muscle strength and joint stability, with fewer reported injuries. The authors advocated for incorporating both strength and endurance exercises into the training programs of working horses to enhance their musculoskeletal health. This research underscored the benefits of diversified training regimens in preventing injuries and boosting performance.

Osei-Yeboah and Adu (2018) studied Ghanaian transport horses, determining that progressive overload training minimized injury risks. The study involved incrementally increasing the workload of horses over a 12-month period, with regular monitoring of their musculoskeletal health. Results showed that horses subjected to gradual increases in workload intensity had lower injury rates compared to those experiencing sudden increases in workload. The researchers recommended a progressive overload approach to training, where workloads are gradually increased to allow horses to adapt and strengthen their musculoskeletal systems. This study emphasized the importance of gradual training adjustments to prevent injuries and promote the health of working horses.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gaps: While Rahman (2019) focused on strains and sprains from high-intensity work, there is a need for research on other types of musculoskeletal injuries, such as fractures or chronic conditions, across varying exercise regimens. Moffat and Hodgson (2019) analyzed muscle recovery using specific biomarkers, yet there is limited information on the long-term impacts of different exercise regimens on overall equine health and performance. Future research should include comprehensive recovery metrics such as behavioral changes and long-term health outcomes. Studies like those by López-Alonso (2020) emphasized joint health, but a broader understanding of the holistic effects of exercise regimens on cardiovascular, respiratory, and overall systemic health in working horses is needed.

Contextual Gaps: Hindle and Horner (2021) addressed workload management in competitive equines, yet the specific needs of non-competitive, working horses such as those used in agriculture or transportation are less studied. Research should contextualize workload strategies to these environments. Fawole (2019) highlighted the importance of rest, but the optimal balance between work and rest periods in different climatic and working conditions remains unexplored. Context-specific studies are essential to determine these balances in varied working environments. Khan (2020) and Osei-Yeboah and Adu (2018) demonstrated the benefits of mixed and progressive training regimens, respectively, but there is a need for context-specific training programs tailored to the unique demands of different working scenarios and horse breeds.

Geographical Gaps: While research has been conducted in Bangladesh (Rahman, 2019), Spain (López-Alonso, 2020), Australia (Moffat & Hodgson, 2019), and Nigeria (Fawole, 2019), there is a significant lack of data from other regions such as Latin America, the Middle East, and other parts of Asia and Africa. Comparative studies across diverse geographical locations can provide a more comprehensive understanding of musculoskeletal health in working horses. The impact of different environmental conditions on exercise regimens and musculoskeletal health is under-researched. Future studies should explore how varying climates, altitudes, and working terrains in different geographical regions affect injury rates and recovery times. The influence of local cultural practices on horse care, exercise routines, and injury management has not been thoroughly examined. Understanding these cultural factors is essential for developing region-specific guidelines and recommendations for maintaining musculoskeletal health in working horses.

CONCLUSION AND RECOMMENDATIONS

Conclusions

The effect of exercise regimens on the musculoskeletal health of working horses is a multifaceted issue that requires careful consideration of exercise intensity, duration, and recovery practices. Research indicates that high-intensity and continuous workloads significantly increase the risk of musculoskeletal injuries such as strains, sprains, and chronic conditions, highlighting the importance of implementing balanced exercise programs. Interval and mixed training regimens have been shown to improve joint health and overall musculoskeletal resilience, while shorter, frequent exercise sessions with adequate rest periods promote optimal muscle recovery. Moreover,

workload management strategies that incorporate regular rest and recovery are crucial in preventing injuries and enhancing performance. Contextual and geographical factors, such as working conditions, environmental impacts, and cultural practices, must also be taken into account to develop effective and tailored exercise regimens for working horses. Addressing these considerations can lead to improved health, welfare, and productivity of working horses globally. Future research should continue to explore these variables to provide comprehensive guidelines that support the sustainable and humane use of working horses in various industries.

Recommendations

Theory

Future research should integrate more comprehensive biomechanical models that consider the unique physical demands of different working environments and tasks performed by horses. This can provide a deeper understanding of the specific stress points and injury mechanisms in working horses. Develop holistic health frameworks that not only focus on musculoskeletal health but also include cardiovascular, respiratory, and overall systemic health, considering the interconnectedness of these systems in equine health. Incorporate studies on the behavioral and psychological impacts of exercise regimens on working horses, recognizing that stress and mental well-being can influence physical health outcomes.

Practice:

Implement balanced exercise programs that mix high-intensity and low-intensity activities, and ensure shorter, frequent exercise sessions to promote muscle recovery and reduce overuse injuries. Adopt interval training regimens that alternate between periods of high and low intensity to improve joint health and overall musculoskeletal resilience. Ensure regular rest periods are integrated into work schedules to prevent chronic musculoskeletal conditions and allow for adequate recovery, particularly in high-demand environments. Tailor training programs to the specific needs and conditions of different working horses, taking into account factors such as breed, age, workload, and environmental conditions.

Policy

Establish regulations that limit the maximum workload and duration of work for horses, ensuring that they are not subjected to continuous high-intensity tasks without adequate rest. Mandate rest and rehabilitation periods for working horses to prevent chronic injuries and ensure long-term musculoskeletal health. Develop and implement training and certification programs for horse handlers and owners on proper exercise regimens, injury prevention, and musculoskeletal health management. Encourage further research and allocate funding to study the effects of various exercise regimens on the musculoskeletal health of working horses across different geographical regions and work environments. This will provide data-driven insights to inform policy and practice.

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