Review

Integrating sports industry development with national health promotion: A biomechanics-informed study of the healthy China strategy

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Abstract: China's strategic objective of promoting national health is in line with the integration of the sports business with sports promotion programs. Biomechanics, which delves into the mechanical aspects of human movement and its interaction with the surrounding environment, is a linchpin in this integration. When it comes to the construction of sports venues and sports equipment development, biomechanical principles are fundamental. For example, the selection of surface materials for tracks, courts, and fields must consider factors such as ground reaction forces, coefficient of friction, and energy dissipation. These biomechanical parameters not only influence an athlete's performance but also play a crucial role in injury prevention. Policies promoting the development of sports venues, increasing public access to recreational facilities, and investing in community health programs remain essential for expanding sports participation and promoting fitness. Through an examination of policy frameworks, economic benefits, and social impacts, this study identifies key factors facilitating this integration. Technological advancements, such as the use of inertial measurement units (IMUs) and force-sensitive sensors in sports equipment and training facilities, enable real-time monitoring of biomechanical variables like joint angles, muscle activation, and movement velocities. Public-private collaborations can then leverage these technologies to develop innovative biomechanics-based sports products and services, making them more accessible to the general public. The findings of this study emphasize the necessity of a comprehensive strategy for sports promotion and sector expansion. This strategy should not only focus on economic gains but also aim to achieve superior health outcomes. Biomechanics-informed sports promotion allows for a more in-depth understanding of how different physical activities impact the human body's biomechanics. This knowledge can be used to customize exercise programs according to an individual's anthropometric and biomechanical characteristics, ensuring maximum effectiveness and safety. From a social perspective, a health-conscious society with widespread access to sports resources can significantly enhance the quality of life. By minimizing the risk of injuries through biomechanics-optimized sports facilities and equipment, individuals can engage in a more active lifestyle, leading to a reduction in healthcare costs. Moreover, as people participate in sports events, fitness challenges, and wellness campaigns, the shift in public attitudes towards fitness can strengthen social cohesion and community engagement. In conclusion, this study offers recommendations for future legislation and programs to enhance the integration of the sports sector with public health promotion. By fully integrating biomechanics into the development of the sports industry, we can ensure a substantial contribution to the "Healthy China" goals, fostering a more robust sports economy and a healthier society.

Keywords: healthy China; sports industry; sports promotion; strategy; business; biomechanics

1. Introduction

The sports industry and sports promote numerous positive aspects in the physical, psychological as well as sociological domain of human life. Therefore, exercising is a good way of keeping the heart healthy and sound, gaining muscle strength, and attaining and maintaining the required body mass. Physiologically, sports help to speed up a child's brain development, relax, and build emotional coping skills. Socially, they enhance teamwork and communication to facilitate community cohesion, and personal relationships among the persons. Further to the above benefits of participation in sports, it can also increase discipline, time management, and goal setting. Therefore, sports aid in improving the well-being of a person and, in the process, balance the life of a person by making him or her active throughout their lifetime. The evolution of the sports industry has grown to be one of the biggest economic sectors in the world. Sport throughout the centuries reflects social, technical, and cultural development processes and is a responsible generation of modern culture [1]. Sports used to be a form of physical exercise and pleasure that was only for individuals or, at most, a small group of people. Over time, sports were systematically challenged and gradually developed into organized-styled events to better promote the formation of sports clubs, leagues, and tournaments. With advancing technological development during the Industrial Revolution, the working class was able to afford leisure time; therefore, sports assumed professionalism.

Global television and later the internet were examples of technological advancements that led to the expansion of sports and their trans-nationalization. The formation of the global sports market has led to athletes, teams, and events becoming significant business entities with massive international followership. Mega-events and broadcast rights for apparel and products turned sports into an economic business structure that involved not only the athletes and the sports organizations but also industries, such as the media and technology, among others [2]. The sports sector of any country also provides employment opportunities, encourages tourism, and creates opportunities for the development of infrastructure. Large metropolitan areas experience events such as the Olympics or World Cup, which create significant returns, attract tourists, and spur development in associated infrastructures. Professional sports leagues and clubs have also brought benefits to local and national economies by providing employment opportunities, bringing sponsorships, and improving economic growth and development through ticket sales, merchandise, and sale of media rights. Sports marketing as a part of this development have seen both sports organizations and governments and corporations spend more money on marketing to foster participation and viewership [3]. Earlier forms of sports promotion included newspaper, radio, and television, especially during the early 1980s. At present, for spreading information about sports, there are numerous social media platforms available. Fan base communities are integrated, social networks and services are used for game broadcasting and streaming, captivating websites are used across all platforms to entice fans, and more coverage is sought for important sporting events. Sports promotion is realized through the promotion of social media accounts, influencers, and admirer engagement, contributing to the success and development of sports all across the world. Additionally, the advertising of spectacles and spectators

work hand in hand, to encourage people to attend particular sporting events. The use of grassroots organizations to help the youth participate in sports as governments and organizations embrace the positive effects of sports on the health of their citizens' democracies. Facilitating a culture of school sports participation, community sports associations, and public health activities complement the professional promotion of sports to develop a healthy society and maintain demand for sporting activities at every level [4]. The objective of this study is to investigate how China's "Healthy China" policy integrates the growth of the sports sector and sports promotion. It seeks to identify important frameworks and policies that promote community health initiatives, public access to fitness facilities, and the expansion of sports venues. The goal of the study is to investigate the technological, social, and economic forces that propel these industries' integration. It also seeks to emphasize how public-private partnerships contribute to the development of a health-conscious society. The study's ultimate goal is to offer suggestions for improving the cooperation between industrial growth and sports promotion.

Sport has a crucial role in human existence by altering socioeconomic situations and preparing people for daily living. Sports have expanded more quickly as a result of globalization, allowing for record-breaking feats and putting strength and competition to the test. Athletes' transfer fees, international world clubs, billions of sports organizations, advertising, sponsorship, and sports facility investments were some examples of the economic repercussions [5]. 31 Chinese provinces' high-quality economic and digital economy development was assessed using the entropy technique between 2010 and 2019. It demonstrated how innovation is driving the digital economy and how the sports industry's strong integration can produce high-caliber products. Both directly and indirectly, advanced technology can support the growth of the local sports business [6]. Although the e-sports sector, which includes professional gaming tournaments has expanded dramatically. The sector and its performance metrics show that destinations were significantly impacted economically. The growth of e-sports depends on government support and strategic initiatives, particularly in the aftermath of the COVID-19 epidemic [7]. From three angles, such as industrial structure advancement, rationalization, and coordination, the structural upgrading assessment indicators used in the sports sector were examined. Positive exchange factors, pressure factors, and negative exchange factors were used to enhance the overall supply model. Five theories on how aggregate supply and demand affect the situation were outlined in Wang [8].

The sports sector was greatly affected by the coronavirus epidemic, which resulted in new practices and adjustments to structures, performance, and goods. The necessity of crisis management plans for upcoming crises was brought to light by the epidemic. Sports managers ought to be ready to foresee requirements and issues in the future and learn from the pandemic's lessons. This necessitated a new perspective and innovative approaches to govern their organizations and adapt to impending challenges [9]. According to Dong [10], the digital economy can save prices, foster innovation, increase industrial production efficiency, and provide individualized services. However, efficiency has not increased much as a result of the early merger of the digital economy and sports, all production aspects require additional improvements. By emphasizing the integration of sports services under governmental

supervision, luring sports culture and tourist fairs, and coordinating the education and tourism sectors with long-term national objectives, the research examined the beneficial link between sports and tourism. Using Internet of Things (IoT) technology, it assessed the correlation; the findings indicate a significant connection consistent with industry standards, trends, and the "environmental protection era," emphasizing the benefits for both environmental and economic sustainability [11].

The necessity for an LCE (Low-carbon economy) to boost public health initiatives and the growth of the sports sector has been brought about by the energy crisis. The evolution of the sports industry, its position in society, and businesses were all covered, which also presents the LCE's function in society. According to the study's findings, the sports sector's added value was rising and would account for 1.14% of GDP (gross domestic product) in 2020. To promote general growth, the study proposed that businesses regulate industry development. Under LCE, the sports sector has developed in a creative way that promotes sustainable growth and improves public health initiatives [12]. China's sports business was expanding quickly, but there were obstacles to overcome. To overcome these obstacles, creative solutions were required. Industry quality was evaluated using the problem, and uncertain information was described. The suggested technique was validated by a numerical case study [13]. Between 2013 and 2017, the study looked at the development of autonomous regions. It found that the sports sector grew incrementally with the help of government policies, whereas the rapid expansion of health insurance allowed the health services industry greater space to expand [14].

A growing disparity and spatial imbalance were shown, which uses coastal regions to exhibit higher resilience. Increasing public involvement and sports market development were among the recommendations [15]. China's sports sector was affected by digital inclusive finance with a particular emphasis on raising rural inhabitants' quality of life. The data from 2015 to 2019 concluded that by changing spending patterns and raising rural per capita disposable income, digital inclusive financing promoted the growth of the sports sector. The body of knowledge on the digital economy offered helpful advice for the growth of the Chinese sports sector [16]. China's leisure sports sector was taking advantage of the country's fitness program to profit from rising consumer demand, health consciousness, infrastructural development, and technology breakthroughs. The national economy's capacity for innovation, talent development, brand marketing, market growth, and social participation must be supported to meet the nation's expanding health demands [17].

2. A review of previous studies and approaches

2.1. Data collection

A wearable device collects data from a sensor, which is then transmitted to a cloud server for analysis. The machine learning model predicts a sportsperson's health status. Preprocessing of sensor data is crucial, removing noise, artifacts, and outliers. Data cleaning removes irrelevant data points and normalization rescales the data to ensure equal importance across features [18]. An examination combines 1600 clips from UCFYouTube.com and HMDB51 data to create 60 training themes, 20 of which are validated and 20 of which are assessed. The KTH file provides 600 clips with

dimensions of 160 px and 120 px, whereas the HMDB51 contents include 6849 films organized into 51 process groupings. The study uses five hybrid combinations of KTH data, 80% for training and 20% for testing, due to the small sample size [19]. The sports industry's health index system, based on operability, hierarchy, systematization, and scientificity, includes 20 indexes and three subsystems: actual health degree, potential health, and supporting environment. The health degree of the sports industry scale, trade, and structure is influenced by factors like added value, legal entities, and lottery sales. The proportion of these factors reflects the industry's health degree [20].

The study [21] involved audio-taped interviews with participants' consent, transcribed verbatim, and lasted 30 to 90 min for each sample. Data collection was divided into two phases: descriptive (initial sampling) and theoretical sampling (deeper understanding and explanation) to provide a comprehensive understanding. The data for indicators like urbanization and aging is derived from statistical data, provinces' yearbooks, linear interpolation, and trend methods. The data for the four regions of Tibet Autonomous Region, Hong Kong Special Administrative Region, Macao Special Administrative Region, and Taiwan is excluded [22]. The Chinese sports industry, as analyzed in a statistical table, experienced rapid growth in size between 2016 and 2020, particularly after the COVID-19 pandemic. Home fitness, smart home fitness equipment, online live sports, and cloud sports events boosted the industry's post-pandemic rejuvenation [23].

2.2. Data pre-processing of previous studies and approaches

The data is normalized or standardized to prevent extreme values from having an undue impact on the final model's effect and to make it easier to compare data using various scales. This is because the human body will experience substantial changes in the data acquired by the sensor when it experiences intense exercise with large amplitudes [24]. Selecting features is used to pre-process data in ML algorithms. Pre-processing involves choosing the optimal feature subset from the big data that can accurately reflect the initial data set and obtaining the low-dimensional representation of this information from the high-dimensionality data collection [25]. Considering the size and diversity of big data, which alters the initial data's quality and layout, data analysis demands comparatively high-quality information. To increase the standard of the data, pre-processing must be done before data analysis. Data integration, data cleansing, and data duplication removal are the three primary facets of data preparation technology [26]. Pre-processing is a crucial step in machine learning pipelines, involving data cleaning and data normalization to ensure accuracy and consistency in sensor data. Data cleaning removes irrelevant data points, while data normalization rescales the data to ensure equal importance across all features [18]. Data pre-processing involves sorting video frames into a system of video frames, determining the training requirement, cultivating and evaluating video frames, converting them into tensor form, and tensor regularization [19].

2.3. Machine learning and deep learning techniques

This section explores the methodologies and analytical techniques employed in sports and health analysis using machine learning (ML) and deep learning (DL). DL

techniques like Deep Neural Network (DNN) [27], Long Short-Term Memory (LSTM) [28], Recurrent Neural Network (RNN) [29], Convolutional Neural Network (CNN) [30], and Generative Adversarial Networks (GAN) [31] (**Table 1**) focus on real-time data modeling for health assessment and action prediction. Various approaches including Support Vector Machine (SVM) [32], Q-Learning [33], Random Forest (RF) [34], K-Nearest Neighbors (KNN) [35], and Decision Trees (DT) [36] (**Table 2**) are applied for motion recognition, and sports performance evaluation, demonstrating high accuracy and reliability. Overall, these techniques enhance decision-making and personalized insights in sports and health contexts.

Table 1. Summary of methodologies and findings in deep learning approaches for sports and health analysis.

Ref	Objective	Methodology	Findings	Limitation
[27]	Evaluate heart health in the elderly.	Developed an elderly health management model using DNN to predict heart health and analyze risks.	Helped improve elderly quality of life and health management through dynamic prediction accuracy 79.6.	Inadequate specific elderly health indicators; lacks broader validation for diverse populations.
[28]	Forecast rehabilitation outcomes for athletes.	Used LSTMs and Big Data to capture temporal dependencies in rehabilitation data. Preprocessing ensured consistency and relevance.	Achieved 85.2% accuracy, precision of 78.6%, recall of 87.9%, and AUC-ROC of 0.91.	Requires extensive historical data; preprocessing is resource-intensive.
[29]	Analyze martial arts fitness data for health activities.	Built LSTM RNN structure for state estimation and feature extraction from fitness data streams.	Accuracy rates of 98.78% to 99.03% with significantly improved data collection.	Limited generalization to non-martial arts fitness data; high computational demands.
[30]	Develop a lightweight IR system for sports towns.	CNN acceleration integrated MobileNetV2-based IR system with FR and ALPR, supported by hardware acceleration.	Achieved 99.46% recognition accuracy for the CelebFaces dataset; met real-time processing requirements.	Hardware dependency for real-time performance; limited testing on diverse datasets.
[31]	Enhance tennis motion recognition and prediction.	Designed LSTM-GAN framework for action prediction, integrating CNN for spatiotemporal modeling.	Achieved 95.0% accuracy, 94.5 F1 score, and high metrics across all evaluations.	Requires complex architecture; performance depends on motion dataset quality.

Table 2. Summary of methodologies and findings in machine learning approaches for sports and health analysis.

Ref	Objective	Approach	Key Findings	Limitations
[32]	Predict injuries in professional sports and optimize player health management.	Utilizes SVM with Recursive Feature Elimination (RFE) on Big Data from athlete records and wearable tech.	Achieved 92.3% accuracy and 87.5% prediction rate.	Could require extensive preprocessing and tuning for complex datasets.
[33]	Personalized sports health recommendation system.	Tracks user preferences, optimizes recommendations using Q-Learning and evaluates through precision and AUC.	Achieved 88.0% precision, 96% AUC, and improved sports persistence by 25%.	Inadequate generalization across diverse sports activities.
[34]	Evaluate and predict student sports performance.	Constructs an RF-based evaluation algorithm with feature importance ranking.	Achieved 68.0% average confidence level in sports effect evaluations.	Could overlook complex interactions among features.
[35]	Recognize emotions and assess accuracy in traditional sports like Baduanjin.	Motion data from IMU was analyzed using k-NN and 1D-CNN for motion recognition.	K-NN achieved 85.0% accuracy; 1D-CNN achieved 99.74% motion recognition accuracy.	Dependent on high-quality feature extraction.
[36]	Improve physical health and sports mode recommendations for college students.	Uses improved ID3 algorithm for decision tree-making and sports recommendations.	Achieved 92.58% motion mode accuracy and 90.02% health decision accuracy.	Partial scalability for large datasets.

3. Integrating the sports industry with public health initiatives

The synchronization of the sports industry with public health goals is the key

approach to improving national welfare and economic development. The promotion of sports at both national and individual levels is synchronized to the health promotion agenda, both governmental and private sectors can effectively target critical areas of concern including physical inactivity, obesity, and mental problems. Promotion of sports to the general populace through organized programs can go a long way in changing the health disposition of the country. The link between business and sports is to support social health-related programs and to deepen the commitment of society to the better health of the nation [37]. The establishment of more social health-related services is a significant strategy for escalating the sports business besides boosting the health as well as economic growth of the nation. The availability of such complexes has also been enhanced in recent years in an endeavor to enhance the participation of members of such societies. Supporting community-based health programs reinforces this relationship even more as people value their health [38].

4. The strategic objective of promoting national health

A technological factor comprises sports science modifications in wearing fitness trackers, apps, and online fitness platforms essential in ensuring that sports are easily embraced and enjoyed. Cooperative efforts with the private sector are important in increasing coverage of sports and fitness for all, especially in the least developed or poorer regions of the country. In this way, the sports industry can effectively promote a healthier populace, energize an economy, and support job creation, especially around events and tourist attractions tied to sporting activities. Harmonizing sports with public health programs has the potential of reaching long-term overall benefits in public health, and economic well-being, some of which include change in populace health risk and disease ability to reduce health cost of the populace, mental and physical wellness, and active populace. Coordination of these sector's strategies could eventually contribute to developing a better sports economy and the general welfare of the population. **Figure 1** shows the role of sports in a person.

Figure 1. Role of sports in a person.

4.1. Reducing healthcare costs through preventative health measures

Primary health intervention strategies are very important in decreasing the future costs that are incurred in the treatment of diseases. They are therefore able to fund their activities and minimize costly admissions and hospitalizations due to healthy diet, exercise, and proper mental health. Community health programs and annual check-ups to identify symptoms of life-altering diseases, including diabetes, heart problems, and obesity, should be supported. The methods are not only cost-effective for healthcare organizations but also increase the well-being of the people and enhance the productivity of society. Also, the encouragement of preventive measures can contribute to keeping insurance costs down and relieve the economy's burden on the health sector. Finally, the overall approach applied to increase public health interest in prevention results in sustainable cost savings in the long term.

Preventative health measures play a crucial role in reducing healthcare costs by addressing health risks before they result in serious illnesses. Key preventative health measures include regular screenings, vaccinations, lifestyle interventions (such as promoting healthy diets and physical activity), and early detection of chronic conditions like diabetes and hypertension. These measures help prevent the onset of severe diseases, reducing the need for expensive treatments, hospitalizations, and long-term care. For example, regular screenings for cancers such as breast and colon cancer can detect conditions early when they are more treatable and less costly to manage. Additionally, promoting vaccination programs can prevent the spread of infectious diseases, thus reducing the burden on healthcare systems. Preventative measures also support health equity by reducing disparities in health outcomes, especially in vulnerable populations. Furthermore, healthy populations contribute to higher productivity and economic growth, making health a key driver of sustainable development. According to the World Health Organization (WHO) and the World Bank, investing in prevention not only improves public health but also delivers long-term economic benefits by reducing the financial burden on healthcare systems.

4.2. Health as a key driver of sustainable development

Well-being is a part of development and healthy people will support social, economic, and natural advancement. Public health also ensures that the impact of diseases on the population is minimized, productivity is improved, healthcare costs are brought lower and the economy is strengthened. People are more productive in health, supported in their role as individuals, and gain education and employment in the long-term economic development. Thus, mainstreaming health makes it possible for a country to have prosperous and sustainable development policies. The idea is well captured under the 'Healthy China' vision, where upgrading population health is wedded to development agendas.

4.3. Integrating health promotion into national policies

Including health promotion into the conceptual paradigms of the given nation-states is indispensable for developing comprehensible strategies for healthy society construction. It makes sure that innovative health concerns are integrated into all areas of human activity as education, transportation, urban development, and farming. The

primary idea of health promotion in national systems is the significance of managing determinants of health, such as the physical environment, individual habits, and the population's access to medical facilities. Such synthesis makes it easier to contain diseases and enhance prevention rather than using money and resources to cure the diseases. As a result, people's health is protected, which leads to healthier people, a healthier society, and far higher productivity [39].

5. Economic growth through sports and fitness programs

Sports and fitness programs for economic growth are one of the key activities undertaken by China as part of its approach to link sports to other aspects of life. Having facilities and programs that foster employment uplifts the economy of a certain spot or country, and assists in the attainment of economic growth of a nation. Physical fitness and sports participation play vital roles for the Chinese populace to maintain a fit workforce, reducing incidences of people spending most of their time in hospitals due to health complications. Additionally, since major athletic events serve as major tourist attractions and generate income, supporting sports and fitness will boost tourism. If China gives more priority to sports promotion, it can develop a sound sports economy that will benefit every sportsperson and the nation as a whole. Sports development and economic growth both complement each other in fostering a sustainable health-conscious society and also achieving the country's financial programs.

5.1. Impact of sports infrastructure on economic development

The provision of sports-related facilities helps generate more opportunities, which aids in economic development. Specifically, physiotherapy clinics, sports arenas, and leisure centers are important as they promote economic activities, attract investments, create employment, and enhance the economic growth of the region. Most of these centres are designed in such a way that they encompass activities from the resident population enhancing the local strategies to surrounding businesses, transportation, hospitality, and retail. The cities and regions with suitable sports facilities and the organizing of municipal and regional games management stand biennial situated neck of the woods provide exotic opportunities for venture capitalists and corporate investment. Therefore, infrastructural expansion in sports facilities improves competitiveness. The development of sports infrastructure is an essential precondition that enables countries to combat the difficult issues facing their nations.

5.2. Job creation and economic opportunities in the sports sector

Internally, employment generation and other connective linkages of sports industry policies and projects are key pointers to national and local developmental processes. From the construction of sports amenities like a football pitch, gymnasium, and recreational facilities, for the youth and companions, job openings come up in the fields of construction, facility management, and maintenance. Outside the necessary tangible facilities, the sports industry creates employment opportunities in management, training, advertising, and sports information. As participation in sports

grows, the availability of employment grows also, as trainers, physiologists, physiotherapists, and employers in the area of wellness.

The other industry that is involved in the creation of employment opportunities is the sports goods and equipment manufacturing industry, as it creates a market for apparel to hi-tech sporting equipment. Sports tourism arising from events such as worldwide competitions generates prospects in meals, accommodation, traveling, and other services, which are advantageous in economic terms for the whole area. Cultivating sports industries is seen as a way that advocates can enhance countries' structural diversification, which bears benefits for both growth poles regions and distant provinces in terms of increased employment opportunities and a new economic outlook [40].

6. Fostering a culture of sports health consciousness in society

Encouraging people and raising their awareness of possible health improvements in society is crucial to leading increasingly active and less strained lifestyles and decreasing the load on health-oriented institutions. They added that it entails coaching people to pursue positive behavior change, exercise and engage in responsible personal behavior toward sustainable health. Community work and most importantly governments, educational institutions, and workplaces have a special task in shaping public healthy habits. Local Astronomy activities, health festivals, and sports for all encourage the community to physically engage in some activities together. When health becomes a priority in societies, people shall be encouraged to be well organized and ensure they work towards improving their health. With these changes, one can receive a better quality of life, save on healthcare expenses, work more effectively, and get a range of other advantages that focus on the person and the entire society with fast-paced positive feedback.

6.1. Promoting healthy lifestyles through public awareness and education in sports

Promoting awareness about lifestyles in connection with existing physical activities in sports will create a high participation level and the health status of the public will improve. By integrating physical education and sports into their classes, schools, and other community centers can effectively increase public awareness of sports. This can be supported by other media campaigns both online and offline, which will extend the appeal and also create awareness of the successes of other local sports persons as appropriate role models. Secondly, collaboration with public health organizations and sports organizations can go a long way in the provision of the necessary sporting equipment and facilities, thus increasing the accommodation of a diverse group of people for sporting activities. Practical nutrition and fitness knowledge can be gained through workshops and training sessions while local sporting activities present opportunities for interfacing. Using such activities, awareness-raising campaigns contribute to the development of lifelong physical activity and sports practices that can lessen public health expenses in the future [41].

6.2. Building supportive environments for physical and mental well-being

Constructing an effective environment to promote the physical and mental health of people is essential to adopting a healthy life and an improved standard of living. Extra support to schools and workplaces is to encourage fitness activity, to offer ways to help with stress and to allow flexible scheduling in the workplace. Further, mental health can be improved using designing silent zones, and gardening areas, and carrying out investigations that support conscious relaxation practices, including meditation and stress control training. Community-related agencies or local healthcare service providers could also help in areas such as conducting well-being seminars, fitness activities, and mental health crusades. In combination, these environments allow people to adopt health-promoting practices integrated into everyday contextual realities and functioning, which creates a strength-focused, health-promoting culture.

6.3. Community engagement and social initiatives for health promotion

Participation of communities and social responsibility in the general society is essential in echoing the availability, rights, and sustainability of health wellness to the affected populace. These activities assemble people; and promote social psychological support that encourages people to observe their health. Activity goals like preparing for a walker, joining a group exercise class, or starting a community gardening program help residents embrace generally healthier lifestyles daily. Thereby the focus is oriented towards the communal organization of the population, where people receive an opportunity to assume leadership on health-associated issues to form a society that is more resistant to threats [42].

7. Increasing public access to recreational sports facilities

The expansion of open recreational sports facilities is imperative as a way of helping the communities embrace health practices, improving the nation's health goals. Well-designed sports facilities inspire regular exercise practices, including team and lone exercises, and improve people's health at different ages. Besides, locating such facilities in such regions can solve problems of inequities and give residents a chance that they would possibly not get in other areas. Making deposits easily available, eliminating or making usage charges low, introducing free or nearly free community activities such as sports, and ensuring that every institution is built with facilities for the physically challenged. An argument for the availability of recreational sports facilities as a health care investment is the fact that besides improving physical fitness, recreation helps in stress relieving and social promotion among mankind. Finally, the increased usage of these resources by the public encourages the growth of a healthy, active society, resulting in improved public health and a decrease in expenditure on health [43]. **Figure 2** illustrates the key features of sports.
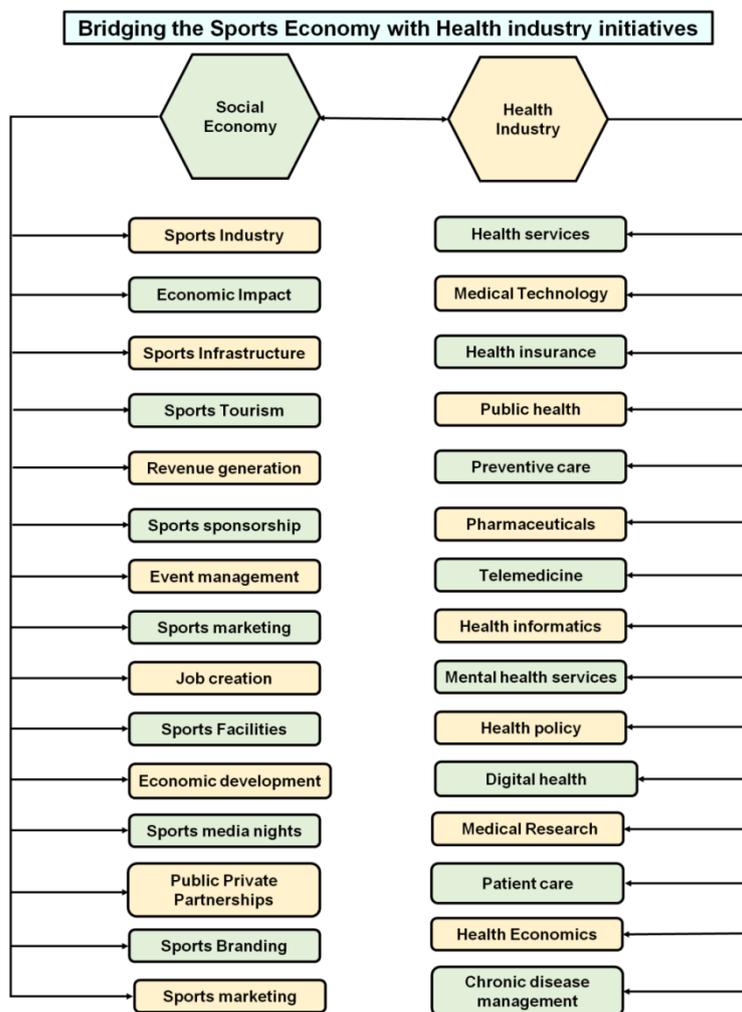
Figure 2. Key features in sports.

8. Social impact of widespread sports participation

Manifold social effects come with increased participation in sports all across the region. Given increased participation in sports, there is a positive enhancement in the standards of people's health, as cases of obesity, cardiovascular diseases, and other illnesses arising from poor living circumstances for the people. Youth stand to benefit from participating in sports due to the many aspects of personal development that the latter enhances, including the creation of discipline, perseverance, and leadership. Many of these lessons are not only learned on the field but are implemented in the classroom and contribute to increased achievement and future occupational success. They also have argued that increased involvement in sports creates demand for sports facilities, sports equipment, and hired service providers, which directly catalyze the creation of employment opportunities and the growth of the relevant economy. Greater availability of sports facilities and sports events can help to promote the greater appeal of communities, enhance property values, and boost people's pride in their town, city, or neighborhood. From a wider perspective, popular automobile national sports programs as well as significant programs and competitions enhance general health and physical fitness activities, endorsing the standards of health departments throughout one's lifespan [44]. Participation in sporting activities enables elderly people as well

as socially excluded groups to interact with other persons. Such programs create awareness of sporting activities in learning institutions and workplaces, thus leading to appropriate health among people. Altogether, a high level of participation in sports develops a healthier and more connected populace and decreases social discrepancies, which makes sports participation a worthy premise that is worth investing in for any society that wants to foster the quality of lives of its individuals [45].

9. Comparative analysis of deep learning and machine learning methods: Accuracy evaluation

The study presents a comparative analysis of the accuracy performance across various deep learning and machine learning methods used in previous studies related to sports industry and health outcomes in **Table 3** and **Figure 3**. To evaluate the following deep learning models: DNN [27], LSTM [28], RNN [29], CNN [30], and GAN [31]. Additionally, it assesses the accuracy of classical machine learning techniques, including SVM [32], Q-Learning [33], RF [34], KNN [35], and DT [36]. By comparing these methods, this study aims to identify the most effective models for predicting and managing sports injuries, with a focus on their predictive accuracy in the context of health outcomes for the Chinese population.

Table 3. Accuracy findings of DL and ML methods in sports industry and health outcomes.

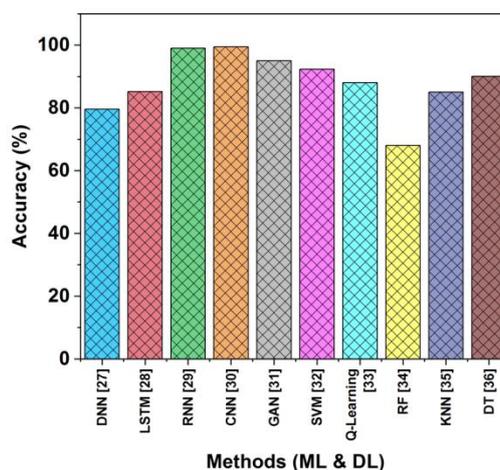| Study	Methods	Accuracy (%)
Deep Learning Methods		
[27]	DNN	79.6
[28]	LSTM	85.2
[29]	RNN	99.03
[30]	CNN	99.46
[31]	GAN	95.0
Machine Learning Methods		
[32]	SVM	92.3
[33]	Q-Learning	88.0
[34]	RF	68.0
[35]	KNN	85.0
[36]	DT	90.02

Figure 3. Accuracy findings of DL and ML methods.

10. Conclusion

The synergistic association of the global comprehensive sports industry with China's "Healthy China" strategy in promoting sports promotional measures has shown the right way to improve public health as well as drive the economy. It therefore becomes evident that to develop a sustainable sports economy, the government, mostly through consultation, needs to support the public and private sectors, provide adequate financial resources for the development of sports infrastructure, and above all ensure that there is formulation and implementation of sports fitness policies. By associating sports development with national health goals, the nation can enhance the physical standards of the people and at the same time increase wealth by developing facilities and production in sports-related industries. Data collection of previous studies, data preprocessing of previous studies, and the methodology and analytical techniques applied in these studies have been critical in assessing the efficiency of diverse sports promotion strategies. Furthermore, the comparative assessments of DL and ML techniques provided their accuracy evaluations and delved important insights into improving the accuracy and efficiency of sports industries related health initiatives.

Technological innovations in sports include managed care sports practices, health-related software applications, and modern-day fitness equipment and this aspect plays a critical role in enhancing participation and resources in sports. Besides, the integration of community-based health programs enhanced the creation of recreational facilities to ensure that people perform their tasks physically, thus cutting on their costs and enhancing their quality lives. Moreover, creating awareness of health consciousness in society can help foster social health cohesiveness that enhances social unity and commitment as well as change people's negative perception towards health and fitness and make physical activities a daily event. Thus, cooperation between the sports promotion and the business provides the key condition and a productive contribution to accomplishing the goals of the "Healthy China" strategic network. The future policies should aim at eradicating discrimination, increasing fairness in the distribution of resources for apparel used during sports, and for the improvement of long-term lifetime health goals and active people as well as

develop an effective and sustainable sports economy beneficial for every person and society.

Ethical approval: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

References

1. McCullough, B.P., Orr, M. and Kellison, T., 2020. Sport ecology: Conceptualizing an emerging subdiscipline within sport management. Journal of Sport Management, 34(6), pp.509-520.https://doi.org/10.1123/jsm.2019-0294

2. Ziakas, V., 2023. Leveraging sports events for tourism development: The event portfolio perspective. Journal of Global Sport Management, 8(1), pp.43-72. https://doi.org/10.1080/24704067.2020.1731700

3. Hindman, L.C. and Walker, N.A., 2020. Sexism in professional sports: How women managers experience and survive sport organizational culture. Journal of Sport Management, 34(1), pp.64-76. https://doi.org/10.1123/jsm.2018-0331

4. González-Serrano, M.H., Jones, P. and Llanos-Contrera, O., 2020. An overview of sport entrepreneurship field: a bibliometric analysis of the articles published in the Web of Science. Sport in society.

5. Orunbayev, A., 2023. Globalization and sports industry. American Journal Of Social Sciences And Humanity Research, 3(11), pp.164-182.

6. Ziming, L. and Kharchenko, T., 2023. Innovations In The Field Of Sports Industry Management: Assessment Of The Digital Economy's Impact On The Qualitative Development Of The Sports Industry. Baltic Journal of Economic Studies, 9(3), pp.10-21. https://doi.org/10.30525/2256-0742/2023-9-3-10-21

7. Kim, Y.H., Nauright, J. and Suveatwatanakul, C., 2020. The rise of E-Sports and the potential for post-COVID continued growth. Sport in Society, 23(11), pp.1861-1871.https://doi.org/10.1080/17430437.2020.1819695

8. Wang, B., 2023. The Relationship between Structural Upgrading and Economic Growth of Sports Industry Based on AD-AS Modeling. Applied Mathematics and Nonlinear Sciences.https://doi.org/10.2478/amns.2023.2.01250

9. Keshkar, S., Dickson, G., Ahonen, A., Swart, K., Addesa, F., Epstein, A., Dodds, M., Schwarz, E.C., Spittle, S., Wright, R. and Seyfried, M., 2021. The effects of Coronavirus pandemic on the sports industry: An update. Annals of Applied Sport Science, 9(1), pp.0-0. https://doi.org/10.29252/aassjournal.964

10. Dong, B., 2022. Dynamic Modeling of High-Quality Development of Sports Industry Driven by Big Data Digital Economy. Mobile Information Systems, 2022(1), p.9131081.https://doi.org/10.1155/2022/9131081

11. Hu, T., Wang, X., He, Q. and Bei, J., 2024. Coupling development of the sports industry and tourism industry based on the Internet of Things. Plos one, 19(4), p.e0299080.https://doi.org/10.1371/journal.pone.0299080

12. Zhang, W. and Mou, C., 2023. Analysis and improvement of sports industry development and public health strategy under the low-carbon economic structure. Frontiers in Public Health, 11, p.1152452.https://doi.org/10.3389/fpubh.2023.1152452

13. Ge, X., Choi, D., Yuan, M. and Yang, Z., 2023. A comprehensive evaluation of high-quality sports industry development in the new era using fuzzy numbers intuitionistic fuzzy sets. Journal of Intelligent & Fuzzy Systems, (Preprint), pp.1-13.https://doi.org/10.3233/JIFS-231502

14. Xu, J., Yang, S., Lin, Y. and Yang, R., 2021. An evaluation of coupling coordination between the sports industry and the health service industry in China. Plos one, 16(8), p.e0256333.https://doi.org/10.1371/journal.pone.0256333

15. Li, Y., Yuan, Y. and Cheng, N., 2023. Analysis on spatial difference and spillover effect of development resilience index of sports industry: A case study of 285 cities in China. Plos one, 18(12), p.e0295313.https://doi.org/10.1371/journal.pone.0295313

16. Huang, H. and Zhang, Y., 2022. Digital inclusive finance and the development of sports industry: An empirical study from the perspective of upgrading the living level of rural residents. Frontiers in Environmental Science, 10, p.1033894.https://doi.org/10.3389/fenvs.2022.1033894

17. Gu, Y., 2023. Exploration of the Development Path of Leisure Sports Industry under the Background of National Fitness. Journal of Innovation and Development, 5(3), pp.112-115.https://doi.org/10.54097/irjto0aw

18. Wang, T.Y., Cui, J. and Fan, Y., 2023. A wearable-based sports health monitoring system using CNN and LSTM with self-attention. Plos one, 18(10), p.e0292012.

19. Yan, F. and Peng, Q., 2024. The Application of Deep Learning in Sports Training. Scalable Computing: Practice and Experience, 25(6), pp.5302-5312.
20. Zhuo, L., Guan, X., and Ye, S., 2020. Quantitative evaluation and prediction analysis of the healthy and sustainable development of China's sports industry. Sustainability, 12(6), p.2184.
21. Gao, W., Feng, W., Xu, Q., Lu, S. and Cao, K., 2022. Barriers associated with the public use of sports facilities in China: a qualitative study. BMC Public Health, 22(1), p.2112.
22. Luo, M. and Chen, L., 2024. The impact of regional sports industry aggregation on residents' health level in China. Scientific Reports, 14(1), p.10928.
23. Tang, Y., Zan, S., Zhang, X. and Zhu, W., 2022. Construction and Development Strategy of an Application System of Intelligent Sports in China's Sports Industry. Mathematical Problems in Engineering, 2022(1), p.3688261.
24. Xu, X., 2023. Research on the Path of Cultivating Socialist Core Values through Campus Sports Data Visualization in the Context of Healthy China. Applied Mathematics and Nonlinear Sciences.
25. Zhou, J. and Tian, L., 2024. Design of A Mobile Big Data Processing-based Sports Health Evaluation System Using a Graph Neural Network. IEEE Access.
26. Yang, K., 2020. The construction of a sports culture industry growth forecast model based on big data. Personal and Ubiquitous Computing, 24(1), pp.5-17.
27. Xiao, L., Huang, L., Chang, H., Ji, L. and Li, J., 2022. Management and Analysis of Sports Health Level of the Elderly Based on Deep Learning. Computational Intelligence and Neuroscience, 2022(1), p.6044320.
28. Cui, Y., 2024. An Efficient Approach to Sports Rehabilitation and Outcome Prediction Using RNN-LSTM. Mobile Networks and Applications, pp.1-16.
29. Li, C., Zhao, M. and Zhao, X., 2023. Status quo and influence of martial arts fitness in pursuit of health using lstm recurrent neural network algorithm. International Journal of Computational Intelligence Systems, 16(1), p.61.
30. Zhou, R. and Wu, F., 2023. Inheritance and Innovation Development of Sports based on Deep Learning and Artificial Intelligence. IEEE Access.
31. Sun, X., Wang, Y. and Khan, J., 2023. Hybrid LSTM and GAN model for action recognition and prediction of lawn tennis sport activities. Soft Computing, 27(23), pp.18093-18112.
32. Li, W., 2024. A Big Data Approach to Forecast Injuries in Professional Sports Using Support Vector Machine. Mobile Networks and Applications, pp.1-17.
33. Yang, Y. and Zhao, Y., 2024. Personalized Sports Health Recommendation System Assisted by Q-Learning Algorithm. International Journal of Human–Computer Interaction, pp.1-13.
34. Liang, K. and Zang, D., 2022. Analysis and Evaluation of Sports Effect Based on Random Forest Algorithm under Big Data. Mobile Information Systems, 2022(1), p.2871481.
35. Li, H., Yap, H.J. and Khoo, S., 2021. Motion classification and features recognition of a traditional Chinese sport (Baduanjin) using sampled-based methods. Applied Sciences, 11(16), p.7630.
36. Chen, W., Yang, G. and Qi, D., 2022. Comprehensive Evaluation of College Students' Physical Health and Sports Mode Recommendation Model Based on Decision Tree Classification Model. Computational Intelligence and Neuroscience, 2022(1), p.5504850.
37. Dai, J. and Menhas, R., 2020. Sustainable development goals, sports, and physical activity: the localization of health-related sustainable development goals through sports in China: a narrative review. Risk management and healthcare policy, pp.1419-1430.https://doi.org/10.2147/RMHP.S257844
38. Westerbeek, H. and Eime, R., 2021. The physical activity and sport participation framework—a policy model toward being physically active across the lifespan. Frontiers in sports and active living, 3, p.608593.https://doi.org/10.3389/fspor.2021.608593
39. Ainsworth, B.E. and Sallis, J.F., 2021. The Beijing 2022 Winter Olympics: An opportunity to promote physical activity and winter sports in Chinese youth. Journal of Sport and Health Science, 11(1), p.3.https://doi.org/10.1016/j.jshs.2021.09.005
40. Shoxrux, S., 2023. The Importance Of Mutual Respect And Kindness In Sports. American Journal Of Social Sciences And Humanity Research, 3(12), pp.215-225.
41. Li, M.H., Whitehead, M., Green, N., Ren, H., Cheng, C.F., Lin, L.L.C., Lin, C.P., Liu, Y., Wen, X., Lei, S.M. and Li, H., 2022. Operationally defining physical literacy in Chinese culture: results of a meta-narrative synthesis and the Panel's recommendations. Journal of Exercise Science & Fitness, 20(3), pp.236-248.https://doi.org/10.1016/j.jesf.2022.04.003

42. Xiong, H., Bairner, A. and Tang, Z., 2020. Embracing city life: physical activities and the social integration of the new generation of female migrant workers in urban China. Leisure Studies, 39(6), pp.782-796.https://doi.org/10.1080/02614367.2020.1800802

43. Wang, L., Dai, Y., Han, L. and Xu, Z., 2024. Optimizing urban resource efficiency: A scenario analysis of shared sports facilities in fostering sustainable communities in Nanjing, China. Journal of Cleaner Production, 468, p.143082.https://doi.org/10.1016/j.jclepro.2024.143082

44. Chen, P., Wang, D., Shen, H., Yu, L., Gao, Q., Mao, L., Jiang, F., Luo, Y., Xie, M., Zhang, Y. and Feng, L., 2020. Physical Activity and health in Chinese children and adolescents: expert consensus statement (2020). British Journal of Sports Medicine, 54(22), pp.1321-1331.https://doi.org/10.1136/bjsports-2020-102261

45. Chadwick, S., 2022. From utilitarianism and neoclassical sports management to a new geopolitical economy of sport. European Sport Management Quarterly, 22(5), pp.685-704.https://doi.org/10.1080/16184742.2022.2032251