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Research on the construction of the "Cloud Mobile Clinic Platform" for physical fitness of college students

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Abstract

This study aimed to develop and evaluate a novel Cloud Mobile Clinic Platform (CMCP) for university students, leveraging big data analytics and cloud computing to integrate online services — including personalized exercise prescriptions, injury prevention, and teleconsultation — with offline support from campus hospital resources, within an O2O framework aimed at enhancing physical fitness and preventing or treating sports-related injuries. The overall framework of Cloud Clinic was discussed using the interview method, and the system design method was applied to design the framework of PC terminal platform, mobile APP and WeChat subplatform to complete the platform construction. The construction of "cloud clinic" in universities will be mainly based on "online and offline combination". The CMCP represents a feasible and innovative approach to address the declining physical fitness of Chinese university students. By facilitating evidence-based exercise guidance, timely injury intervention, and personalized rehabilitation within an integrated O2O ecosystem supported by campus infrastructure, it offers a scalable model for promoting adolescent health and advancing the integration of sports and medicine in the digital health era.

Introduction

With the rapid development of information technology, big data and cloud computing have become important forces driving innovation in various fields of society (Si et al., 2023). In the field of sports and health, especially in the university environment, the application of these technologies has provided new possibilities for improving the physical fitness of college students. This study aims to explore how to integrate big data with the combination of sports and medicine to construct a Cloud Mobile Clinic Platform (CMCP) in colleges and universities, so as to improve the physical fitness level of college students in a scientific and reasonable manner.

College students, as the pillars of the future of the country, their physical health are directly related to the development and progress of the country. However, recent studies have shown that the physical fitness level of Chinese college students is on a downward trend (Zhao et al., 2025; Li, 2025), which not only affects the quality of life of individuals but also poses a challenge to social and economic development. The decline in cardiopulmonary function and the increase in the number of obese people are the main manifestations of the current physical fitness problems of college students (Bao et al., 2025; Sun et al., 2025). The emergence of these problems is partly due to the lack of scientific physical exercise and sports guidance (Zhong, 2018). Therefore, how to improve the physical quality of college students through scientific and reasonable exercise has become an urgent problem for college physical education educators to solve.

In this context, the Chinese government has put forward the "Healthy China 2030" Planning Outline, emphasizing the importance of the integration of sports and medicine and non-medical health interventions, and advocating promoting health, preventing chronic diseases, and rehabilitation through national fitness activities (Jiang, 2024). The development of cloud medicine provides technical support for achieving this goal. At present, there have been many online medical platforms and mobile medical software in China, such as "39 Health Net" and "Good Doctor Online" (Wu, 2016), and these platforms have achieved certain achievements

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in spreading health education and information and providing cloud medical services.

While platforms such as "39 Health Net" and "Good Doctor Online" provide valuable general health information and telemedicine services to the public, their broad target audiences and comprehensive service scope mean they are not designed with the specific requirements of university students in mind. Consequently, they offer limited specialization in core areas relevant to this population—such as exercise prescriptions adapted to campus sports environments, prevention and rehabilitation of injuries common among young adults engaged in recreational sports, and seamless integration with on-campus medical infrastructure within an Online-to-Offline (O2O) framework. These limitations stem from their generalist orientation, rather than from the influence of any single platform. Furthermore, these platforms typically operate in silos, with limited integration between online advice and readily accessible, trusted offline medical resources specifically tailored to campus life, such as university hospitals. This gap highlights the critical need for a dedicated, integrated platform that seamlessly combines online sports medicine expertise with localized, university-affiliated offline healthcare support.

The CMCP is uniquely positioned to address this need because it directly targets the core health challenges of university students — including the high incidence of preventable sports injuries, the lack of scientifically guided training, and insufficient rehabilitation follow-up (Bloemers et al., 2012).

Its key advantages over existing general-purpose health platforms are fourfold:

(i) a dedicated focus on the epidemiology and prevention of sports injuries common in university populations;

(ii) deep integration of campus hospitals, sports science faculties, and student users within a unified O2O framework;

(iii) AI-driven personalization based on real-time physiological monitoring, wearable sensor data, and standardized fitness assessments;

(iv) a closed-loop health management pathway that links preventive screening, timely intervention, and structured rehabilitation follow-up.

These advantages are operationalized through standardized data acquisition and interoperability protocols linking campus medical records and user-generated data, algorithmic decision support for exercise prescription and injury management, and coordinated offline therapeutic and rehabilitation services. This combination of focus, integration, personalization, and closed-loop management equips the CMCP to solve challenges that existing platforms, with their broader consumer orientation and limited institutional integration, cannot address.

This study therefore explores the feasibility and necessity of constructing a university-specific, sports medicine-oriented Cloud Mobile Clinic Platform (CMCP). By deeply integrating online resources (big data analytics for personalized prescriptions, teleconsultation) with guaranteed access to offline university hospital services (emergency care, physiotherapy) (Shin et al., 2025). The CMCP aims to provide a comprehensive solution for scientifically guided exercise, effective injury prevention and management, and personalized rehabilitation, ultimately improving the physical fitness of college students and serving as a model for sports-medicine integration (Long & Liu, 2023).

Methods

The aim of this study was to develop and design a Cloud Mobile Clinic Platform based on big data cloud computing, which is guaranteed by the school hospital and adopts the mode of online and offline integration, in order to improve the physical quality of the college student group. The following are the materials and methods used in the construction of the "Cloud Mobile Clinic Platform".

Research Design

The research adopted a mixed-methodology design, combining qualitative interviews and system design methods. The overall framework of the Cloud Mobile Clinic Platform (CMCP) was discussed using the interview method, and the system design method was applied to design the frameworks of the PC terminal platform, mobile APP, and WeChat sub-platform to complete the platform construction.

Operational Procedures for Qualitative Interviews and System Design

The qualitative interviews involved 28 key informants, including sports science professors, university physicians, and IT specialists. Semi-structured interviews lasting 30–45 minutes were conducted in person or via encrypted video conferencing, guided by a pre-tested interview framework covering functional needs, user interface preferences, technical feasibility, anticipated barriers, and integration strategies with existing campus resources. Interview recordings were

transcribed verbatim, and thematic analysis was performed independently by two researchers, with discrepancies resolved by consensus.

Insights from the interviews informed the system design process, which followed an iterative user centred methodology: (i) translating user requirements into a formal specification; (ii) decomposing functionality into modules (hospital cloud, user cloud, offline services); (iii) drafting the modular microservices architecture; (iv) expert review and refinement; (v) prototype development; (vi) usability testing with representative end users; and (vii) iterative optimization prior to test deployment.

Data Collection

The research team collected opinions from college sports teachers, medical staff, and IT experts through semi-structured interviews to ensure that the platform design met user needs. The interview content covered platform functions, user interface design, and expected technical challenges. In addition, the satisfaction and expectations of college students with existing sports health services were also collected to guide the service design of the platform (Dang et al., 2019).

Participant recruitment and inclusion criteria were as follows:

(1) Students were recruited via open calls distributed through the university's digital bulletin board system and in-class announcements. Eligibility was restricted to full-time undergraduates aged 18–24 who had attended at least one year of regular physical education classes.

(2) Physicians were invited on the recommendation of directors from the campus hospital and affiliated partner hospitals, with inclusion criteria requiring at least five years of clinical experience in sports medicine or orthopaedics.

(3) IT experts were sourced through collaboration with the university's Information Technology Center and contracted professional partners, with prior experience in health-related software or platform development as a prerequisite.

Data for this study were collected between March and June 2025 through three primary sources: (i) qualitative interviews — Twenty-eight key informants (15 sports science professors, 8 university hospital physicians, and 5 IT specialists) participated in semi-structured discussions totaling 1,120 recorded minutes, producing approximately 180,000 words of verbatim transcripts; (ii) student survey — An online structured questionnaire was distributed to 220 full-time undergraduates, yielding 200 valid responses (validity rate: 90.9%) concerning service expectations and satisfaction; and (iii) prototype usage logs — Thirty-five student users interacted with the CMCP prototype for an average of 40 minutes each, with server-side logs capturing module usage frequency, navigation patterns, and time-on-task metrics. Data collection employed encrypted digital audio recorders for interviews, an institutional online survey platform with SSL encryption, and automated backend logging for prototype interactions (Archibald et al., 2019). Quality control measures included double verification of transcript accuracy, independent dual-researcher coding of qualitative data, and computation of Cronbach's alpha (>0.85) to confirm survey reliability.

Platform Architecture Design

System Architecture the Cloud Mobile Clinic Platform (CMCP) implements a modular microservices architecture deployed across distributed cloud infrastructure.

The system comprises two primary online components: the Hospital Cloud Module and the User Cloud Module, complemented by comprehensive offline integration capabilities. The Hospital Cloud Module serves as the central data aggregation and processing hub. It leverages a Hadoop-based data lake architecture to collect and analyze multiple data streams in real-time. These streams include student health records from university medical centers, continuous physiological data from wearable devices through Bluetooth protocols, self-reported exercise documentation, and standardized physical fitness assessments. Advanced analytics pipelines process this heterogeneous data to generate actionable insights for both healthcare providers and students. The User Cloud Module delivers student-facing services through an integrated digital ecosystem. A responsive web portal and native mobile applications provide the primary user interfaces. The module incorporates artificial intelligence algorithms for exercise recommendations, utilizing both collaborative filtering techniques and physiological constraint modeling to ensure personalized and safe activity suggestions. Secure messaging capabilities enable protected teleconsultation sessions, while customizable dashboards present relevant health metrics and progress indicators to each user. The platform achieves seamless offline integration through standardized healthcare interoperability protocols. Direct connections with university hospital systems enable bidirectional electronic health record exchange and streamlined appointment management. This integration facilitates

coordinated emergency response services, allows online booking of physiotherapy sessions, and manages access to prescribed rehabilitation resources. The unified architecture ensures consistent service delivery across both digital and physical touchpoints while maintaining strict data security standards throughout the system. (Rodrigues et al., 2013).

Technical Implementation

The infrastructure construction of the online platform includes the laying of network cables, communication, and the building of other network platforms; the hardware facilities include hosts, storage, data server clusters, and geographic information systems, etc.; the software part includes database construction, development tools, and management tools, etc. (Islam et al., 2015). The realization of these technologies provides a foundation for the stable operation of the online platform.

Security and Privacy Protection

In terms of data security and privacy, end-to-end encryption using the AES-256 standard protects all data in transit and at rest. Access control is governed by a role-based access control (RBAC) model, ensuring adherence to the principle of least privilege. All user identities are strongly authenticated through real-name verification procedures, which are tightly integrated with university identification systems. For research analytics, sensitive data undergoes anonymization to protect individual privacy (Zhu et al., 2012). The system operates in strict compliance with China's Personal Information Protection Law (PIPL) and Cybersecurity Law, incorporating regular third-party audits to validate adherence and continuously refine data governance practices (Sharma et al., 2024).

User Training and Feedback

To ensure the effective use of the platform, we trained all prospective users and collected their feedback after the platform was launched, in order to iterate and optimize the functions. User feedback was collected through online surveys and face-to-face interviews, focusing on user experience, service satisfaction, and technical barriers (Parker et al., 2021).

Ethical Considerations

This study was approved by the Ethics Review Committee of Southwest University, China (Approval Code: SWU-PE-20250317; Approval Date: March 17, 2025), adhering to the Declaration of Helsinki. Participants were informed of procedures, risks, benefits, confidentiality, and withdrawal rights via Mandarin Chinese interviews. Written informed consent was obtained, ensuring voluntary participation and compliance with ethical standards. No compensation was provided. Data were de-identified, with personal information securely stored and accessible only to researchers.

Results

Platform Design and Development Outcomes

Based on a comprehensive requirements analysis involving 15 sports science professors, 8 university hospital physicians, 5 IT specialists, and survey responses from 200 students, the final architecture of the Campus Musculoskeletal Care Platform (CMCP), as detailed in Section 4 and illustrated in Figure 1, was systematically developed. The design prioritized several core functionalities: real-time injury reporting enhanced by AI-assisted first-aid guidance, leveraging natural language processing models trained on authoritative sports medicine literature; personalized exercise prescription generation, informed by physiological data and user activity preferences, and grounded in the algorithmic framework proposed by Ravi et al. (Ravi, Wong, Lo, Yang, & informatics, 2016); and a streamlined appointment scheduling system seamlessly integrated with the campus hospital's electronic health record (EHR) infrastructure, validated through API-based simulations. A functional prototype incorporating these key modules has been successfully deployed within a controlled test cloud environment, laying the groundwork for iterative development and user-centered refinement.

Building upon the overall platform development outcomes, the following section details the architectural framework and operational mechanism of the university's 'Cloud Mobile Clinic Platform' as a core component of the system.

Framework Design and Operation Mechanism of University "Cloud Mobile Clinic Platform"

"Cloud mobile clinic platform" starts with "Cloud" and "Mobile", combines various online and offline resources and services, integrates the unique advantages of medical and sports talents, expands the service objects and influence of the clinic, and realizes the two-way interaction of online to offline. "Clinic": (i) focus on diagnosis and prevention before exercise. This project focuses on monitoring various physical indicators of athletes, diagnosing exercise methods and methods, and

recommending appropriate exercise items and scientific exercise methods and methods according to their index data. (ii) treatment for physical and psychological trauma caused by sports, or problems diagnosed in sports technology. “Platform”: there are not only fixed places to select some qualified existing hospitals to join the system, but also virtual places to conduct diagnosis and treatment through the Internet and provide relevant services.

The design of “Cloud mobile clinic platform” is divided into two parts: online and offline. The online platform is mainly divided into hospital and user. (i) Hospital. It includes customer information collection and platform sharing resources, the former is responsible for collecting customers' basic personal information, past medical history, sports records, wearable devices, real-time injury, physical fitness test and whether to arrange numbers and make appointments with experts; the latter is responsible for collecting and sorting out various sports injury prevention and emergency measures, and the classification of people suitable for various sports events Relevant shared resources such as recent events and sports skill improvement programs (Bajpai et al., 2019); (ii) User. It is composed of customers' daily diagnosis and injury treatment (Alessa et al., 2018). Based on the hospital cloud data framework, it provides customers with daily services such as taboo item judgment, event activity and sports item recommendation, and provides customers with personalized services such as emergency measure push, expert online diagnosis, difficult case consultation, personalized drug prescription, rehabilitation system tracking and electronic case archiving, Communication between customers, doctors and customers can also be carried out in the cloud (Figure 1).

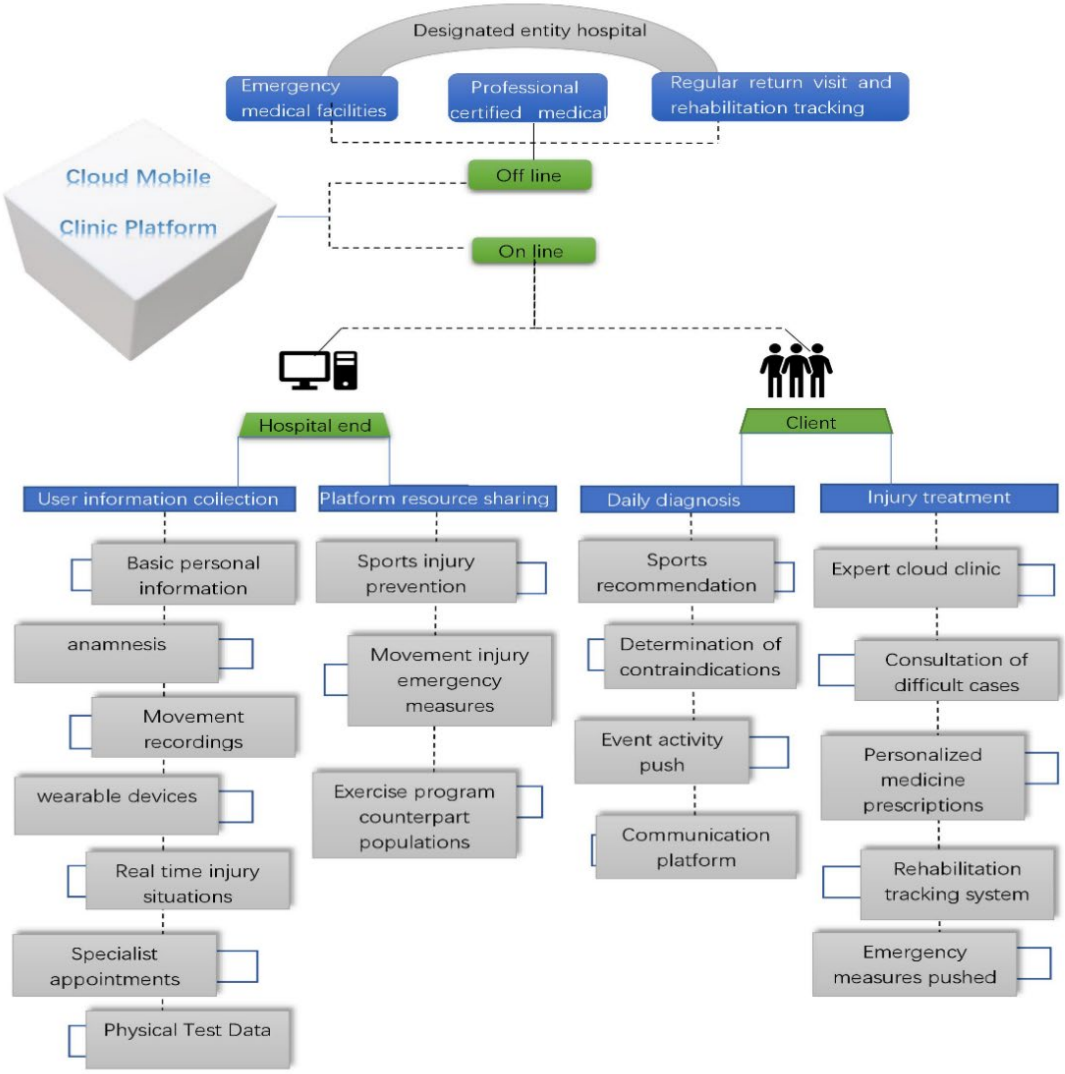

Figure 1. General framework of cloud mobile clinic platform.

Online Service

Infrastructure

Platform infrastructure construction mainly includes network, arrangement of wire, communication and other network platforms; Hardware facilities: host, storage, data, server cluster, geographic information system, etc. required for integrated processing; Software part: such as database construction, development tools, management tools, etc. Perfect platform infrastructure is the foundation of online platform construction (Hashem et al., 2015).

Service framework of online service

Online service mainly includes two sections: hospital cloud and user cloud. Hospital cloud information collection and sharing resources (Aceto et al., 2020). Collect user basic information, shared resources and other original data, and use big data technology for in-depth processing and integration to build cloud hospital database (such as customer document database, hospital resource database, diagnosis and treatment database, etc.). Store and integrate the basic personal information, past medical records, sports records, wearable devices, real-time injury conditions, physical fitness tests and other data uploaded by the client to form a customer document database. The hospital resource database includes sports injury prevention measures, sports injury first aid measures, characteristics of various sports events, suitable people Sports skill improvement program and real-time national event summary. The core role of the shared database is two aspects: first, it is conducive to the platform to provide services such as personality analysis of customers' basic situation, fitness status early warning, sports project selection, formulation of personalized treatment plan and rehabilitation tracking; Second, it is convenient for customers to directly obtain various sports introduction, sports fitness guidance, injury emergency measures and personalized treatment schemes from the terminal.

User cloud service area. The Cloud mobile clinic platform in colleges and universities mainly serves college students, which is subdivided into daily diagnosis users and injury treatment users according to user needs. Users enter the platform through registered members to upload real and effective basic personal information, and selectively upload past medical records, physical test data, sports records, wearable devices and other materials. At the same time, the system is equipped with information security system (including network security, system security and Application Security) to ensure the privacy and security of users' information. The Crucial contents of cloud services for daily users: (a) sports recommendation. The platform recommends sports items suitable for users' physical fitness according to the physical fitness test data, sports records, characteristics of various sports items and other data uploaded by users, so as to reduce sports damage and ineffective exercise caused by the choice of sports items that are not suitable for their own physical fitness; (b) Judgment of taboo events. According to the user's physical characteristics and previous medical records, the user's taboo sports are selected, mainly for the youth with previous medical history; (c) Event push. Under the call of national fitness, college people continue to pay more attention to all kinds of sports and competitive events. Most large-scale event information will be published on mainstream sports website, but the information of some small and unpopular sports events cannot enter the public view. The platform will collect and integrate all kinds of sports event information and push it to users regularly; (d) Personalized sports skill improvement program. According to their own needs, users can obtain personalized sports skill improvement schemes based on their physical fitness level on the platform (Aroganam et al., 2019); (e) Communication platform. This refers to two types of communication. One is the dialogue between users and professional doctors. Users can consult doctors online about exercise therapy related problems according to their own needs. The other is the dialogue between users. Users can share their feelings about exercise and exercise therapy effect through the communication platform.

Key service items for injury treatment users: (a) push of emergency measures (Roncero et al., 2020). Most college students' awareness of sports injury prevention is relatively weak. They often cause sports injury in the process of sports. Users with minor sports injury caused by improper sports methods or other factors can report clinical symptoms on the platform, obtain injury first aid and treatment measures for self-treatment, so as to achieve the effect of slowing down and treating injury, Users with serious injuries need to take self-first aid measures under the guidance of platform staff to avoid secondary injury, and then carry out online or offline diagnosis and treatment services; (b) Expert online diagnosis. When the first aid and treatment measures for sports injury set by the system itself cannot meet the needs of users, users can choose experts for consultation to diagnose and treat the injury category or degree. Consultation is divided into online consultation and offline consultation. Users can choose different

consultation methods according to their own needs (Van der Kruk & Reijne, 2018). (c) Consultation of difficult cases. For users whose individual diseases are complex and serious and cannot be diagnosed by local hospitals, the platform provides online consultation of difficult cases by a team of expert doctors; (d) Personalized drug prescription. With the deepening of sports medical informatization, the traditional empirical treatment mode will be completely replaced by the personalized diagnosis and treatment service mode. The remarkable characteristics of the personalized diagnosis and treatment service mode are: data support, personalized prescription, reservation, process integration, collaborative service and effect driven. The platform provides personalized diagnosis and treatment services for users with sports injuries or difficult diseases whose bodies cannot repair themselves. Users can obtain personalized drug prescriptions for treatment after consultation; (e) Rehabilitation tracking system. This service mainly provides regular return visit and guidance for pathological diagnosis and treatment users; (f) Electronic case archiving. The case information of users shall be archived in network security. This file is highly confidential and can be shared by users and third-party platforms.

Offline Service

The construction of Cloud mobile clinic platform will be based on the combination of online and offline, and conform to the requirements of the Internet plus era. It based on the fixed point Medical Hospital (School Hospital + university nearby hospital), the data interconnection and resource scheduling between cloud mobile clinics and physical hospitals can be realized, such as electronic case sharing, emergency medical field rescue, etc. Cloud consultation + physical treatment, drug distribution management, online appointment registration + offline physical consultation, etc.

Selection of designated hospitals

The offline designated physical Hospital of Cloud mobile clinic platform of colleges and universities is determined as the hospital of major colleges and universities (Bashshur et al., 2014). The selection of offline designated hospitals of the platform is affected by comprehensive factors such as geographical environment, capital and the particularity of service objects. The selection of university hospitals is mainly based on the service objects of University Cloud mobile clinic platform - university students. This choice is conducive to the efficient interaction between users and the platform. For example, when the online platform cannot meet the needs of users, the platform can provide safe and reliable offline services nearby, which can avoid the safety problems of students going out of school for medical treatment to a certain extent. In addition, the university hospital also serves as an important channel for platform publicity. In the early stage of platform operation, the university hospital will also serve as the main publicity channel, such as registering the platform account and enjoying medical benefits on the platform. If the off campus hospital is selected, there may be problems such as the safety of users' travel for medical treatment and missing the best rescue time. In conclusion, the university hospital should be the best choice for the offline designated hospital of the Cloud mobile clinic platform of the University.

Establishment of medical team

Establishing a high-quality professional medical team is a necessary content of the construction of any medical institution. If you want to provide users with high-quality medical services, you must establish a high-level medical team.

Table 1
Summary of CMCP modules, functions, and target users.

Module	Core Function	Target User(s)
Hospital Cloud Module	Collect and integrate student health records, sports injury prevention protocols, emergency treatment measures, sports skill databases, and event info	University physicians, medical staff
User Cloud Module – Daily Use	Personalized exercise recommendations, taboo event judgment, event information push, sports skill improvement programs, peer and doctor communication	Students, coaches
User Cloud Module – Injury Care	Emergency first-aid push, expert online diagnosis, complex case consultation, personalized drug prescription, rehabilitation tracking, e-case archive	Students, physicians
Offline Service Module	On-site treatment, physiotherapy sessions, emergency medical rescue, offline consultations, platform promotion through university hospitals	Students, physicians, platform managers

The medical team of Cloud mobile clinic platform in Colleges and universities needs to do different work contents of "online", "offline" or "Online + offline". The platform will recruit excellent doctors from various sports medical fields to form a high-level professional doctor team (the team can include excellent doctors in Colleges and universities). At the same time, the original medical team will be reorganized according to the specific situation of each university hospital, so as to achieve high utilization rate of medical human resources.

Medical team management

The high efficiency, complexity, security and other special characteristics of the operation of Cloud mobile clinic platform in Colleges and universities require that the platform not only needs professional medical staff, but also effectively manage the team. In order to ensure its continuous and efficient operation, the platform will formulate various rules and regulations and behavior standards to standardize the work content and behavior of all medical staff, implement the assessment system, and implement reward, punishment, demotion, promotion and other measures for those who violate the rules and regulations of the platform or love their Posts and dedication. Injecting fresh blood into the team is also an important part of team management. The platform will also regularly carry out work and ideological training for all medical staff to help them understand their work responsibilities and abide by professional ethics and ideological ethics. While working steadily, they will strive for excellence, pursue excellence and be brave in innovation to jointly realize the efficient service of the platform.

Discussion

Comparative Advantages of the CMCP over Existing Digital Health and Fitness Platforms

The “Cloud Mobile Clinic Platform” (CMCP) demonstrates clear differentiation from existing health and fitness platforms in China, both in terms of functional positioning and integrated service depth. While platforms such as “39 Health Net” and “Good Doctor Online” offer broad-spectrum health consultations and web-based medical services, they lack domain specificity in sports medicine and do not cater to the health and wellness needs of a highly localized and well-structured population such as university students (Roncero et al., 2020). These commercial platforms also fall short in integrating with trusted on-campus healthcare resources, limiting their applicability in closed-loop campus healthcare ecosystems.

In contrast, commercial fitness and activity monitoring apps, such as “Dongdong”, “Yuepaoquan”, and “Nike Run Club”, provide useful tools for tracking activity levels but are largely generic in their health guidance. They do not offer personalized, evidence-based interventions or direct clinical integration with medical services, much less with university-based healthcare systems. Apps like “Well”, which venture into the rehabilitation domain, often lack scalability and personalization and fail to address the broader requirements of student populations such as preventive health education, intelligent injury triage, and structured follow-up via university sports medicine services.

The CMCP's value lies in its vertical specialization (focused on the sports health and physical fitness challenges of Chinese college students) and horizontal integration (connecting school hospitals, physical education faculties, and students through an Online-to-Offline (O2O) model). This robust model not only addresses common campus issues such as sports injuries, training overload, and lack of professional exercise guidance, but also aligns with students’ digital habits and their trust in institutional services. More importantly, it establishes a novel data-driven O2O infrastructure, offering a seamless experience from exercise prescription to sports training, injury support, diagnosis, and recovery—all anchored within the university ecosystem.

Implications for Policy Alignment: Realizing the Goals of “Healthy China 2030” and “Sports-Medicine Integration”

The construction of the CMCP offers strong alignment with China's national strategic plans, especially the “Healthy China 2030” blueprint and the policy directives surrounding sports-medical integration. These initiatives emphasize preventive healthcare, personalized guidance, and institutional reform to modernize fitness infrastructure.

As outlined in the “Healthy China 2030” plan, there is a policy-level call to establish exercise prescription systems, tailored for diverse populations and health conditions. At the same time, it encourages the formation of cross-disciplinary ecosystems encompassing medicine, sports science, and information technology. However, existing implementation is fragmented—education and medical systems often work in silos, and students remain

underserved in terms of data-based, scientifically grounded health interventions.

CMCP directly addresses these challenges. By embedding digital first-aid assistance, real-time injury reporting, and personalized rehabilitation within a single platform—and integrating these with the university hospital's EHR system—the platform operationalizes the vision of preventive, patient-centered, and technology-enabled healthcare at the population level, beginning with a critical demographic: youth in higher education.

Furthermore, the platform acts as a behavioral modifier, gradually reversing the traditional notion of "seeking medical care only when ill" by embedding health services in daily student life. By enabling proactive screening, monitoring, intervention, and education, CMCP promotes a culture of preventive health while also improving data-based accountability for student fitness programs.

Core Contributions and Innovation Highlights of the Platform

This study presents several original contributions that collectively advance the state of technology-assisted public health interventions within the university context: 1. First integrated university sports medicine O2O platform The CMCP represents the first comprehensive university-based digital health platform in China to deeply integrate sports medicine, digital health services, and school-level medical infrastructure. Unlike existing standalone digital apps or online health services, CMCP creates a true service loop, where students receive intelligent exercise guidance, real-time injury reporting, AI-assisted triage, and an automatically coordinated pathway to on-campus clinic appointments.

2. Harnessing closed-campus resources for an efficient service ecosystem By leveraging localized resources—including school hospitals, sports science faculties, and student digital engagement—the platform minimizes barriers to adoption. This resource-concentrated ecosystem ensures that services are not only tailored but also accessible, cost-effective, and culturally trusted, circumventing many limitations of top-down public health interventions.

3. Big data foundation for student health records & decision support with strong support for standardized data collection, including past medical histories, physical condition profiles, and exercise performance logs, CMCP builds a data-driven foundation for long-term health tracking and precision prescription. These user datasets are shared between collaborating departments under strict privacy protocols, facilitating joint health-sports decision-making and powering research in health analytics.

4. Practical training ground for interdisciplinary sports-medical talent The platform not only serves students but also acts as a training and research environment for future professionals in sports medicine, rehabilitation, sports psychology, exercise physiology, and digital health management. Trainees participate in real case evaluations, data collection, personalized prescription design, and digital service delivery implementation—addressing current issues of employment mismatch and practical experience deficiency among sports science and medical graduates.

Addressing Key Problems Identified in the Study

The platform was explicitly designed to respond to problems identified in prior research and campus surveys. These include:

Decline in student physical health: National surveys and institutional data indicate a downward trend in college students' physical fitness (Tan, 2020). CMCP directly addresses this via personalized, data-driven exercise prescriptions and consistent monitoring.

Frequent sports injuries and lack of guidance: The platform provides real-time injury reporting and AI-powered first-aid guidance, reducing the harm caused by delayed or empirical treatments and offering structured rehabilitation plans rooted in sports medicine.

Knowledge deficit in scientific exercise principles: By offering educational prompts and structured health guidance within an interactive interface, CMCP fills the gap in sports health literacy among students who know they should exercise but lack the knowledge or training to do so safely and effectively.

Broader Impacts and Future Prospects

Looking ahead, the platform shows promise as a scalable model for both policy innovation and digital health delivery in educational environments. It could be readily adapted to vocational colleges, secondary schools, and even community sports centers, thereby bringing the benefits of the system beyond the campus environment.

With growing emphasis on precision public health, CMCP can potentially support more granular policy reforms and even contribute data for real-time population health surveillance and feedback optimization. Furthermore, its holistic structure—integrating technical platforms, medical knowledge, institutional healthcare systems, and student behaviors—offers an open template for

multidisciplinary innovation, from AI-enhanced diagnostics to campus wellness research hubs.

Limitation

This study presents the conceptual design and feasibility assessment of the Cloud Mobile Clinic Platform (CMCP), proposing an innovative model for integrating sports medicine and digital health services in university settings. However, several limitations must be acknowledged. First, the platform's actual effectiveness in improving physical fitness outcomes and reducing sports-related injuries among college students has yet to be empirically validated. Robust longitudinal studies and randomized controlled trials will be required post-deployment to assess its clinical and behavioral impacts.

Second, the integration of diverse data sources—such as wearable devices, electronic health records from campus hospitals, and manually entered user information—presents persistent challenges in terms of data standardization and interoperability. Efficient cross-system data fusion is essential for accurate analysis and personalized recommendation generation, and remains a key technical barrier.

Third, the generalizability of the CMCP model across universities with varying levels of digital infrastructure, medical resources, and institutional readiness remains uncertain. Further investigation is required to determine how the platform can be effectively adapted and scaled across heterogeneous campus environments.

Looking ahead, future work will prioritize pilot implementations at selected partner universities to assess operational feasibility, user engagement, and health impact. Additionally, efforts will be directed toward refining the platform's AI-driven prescription algorithms through the incorporation of real-world user data, thereby enhancing personalization and predictive accuracy. Exploring sustainable operational models, including collaborations with campus health insurers, sports organizations, and commercial partners, will also be crucial to support long-term viability. Finally, the platform's potential as a training and research environment for cultivating interdisciplinary talent in sports medicine, health informatics, and rehabilitation will be systematically evaluated to support education-driven innovation.

Conclusion

This study presents the design and feasibility assessment of the Cloud Mobile Clinic Platform (CMCP), a novel Online-to-Offline (O2O) health ecosystem developed to address the decline in physical fitness and the high prevalence of sports injuries among Chinese university students. By integrating data-driven online services—such as personalized exercise prescription, injury prevention guidance, and remote consultation—with direct access to university hospital resources, the CMCP offers a scalable model for promoting evidence-based physical activity, timely medical intervention, and individualized rehabilitation.

Its successful deployment could significantly improve student health outcomes and serve as a replicable framework for integrating sports science and clinical care within China's broader digital health infrastructure, directly supporting the objectives of the "Healthy China 2030" initiative. Future research will focus on empirically validating the platform's impact through longitudinal and controlled studies, and on developing sustainable operational models to support long-term implementation and cross-institutional scalability.

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Authors' Contributions

GCL and GDZ designed this study. GCL collected training programs. GCL analyzed data. GCL, wrote the first draft of the manuscript. All authors contributed to the final manuscript.

Availability of Data and Materials

The data generated and analyzed in this study are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare that there is no conflict of interest.

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