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Application and Analysis of Big Data Mining in Health Management of Chronic Diseases Based on the Internet of Things

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Abstract: Objective: To analyze the application effects of big data mining in the health management of chronic diseases under the premise of the Internet of Things (IoT). Methods: A total of 188 high-risk individuals with chronic diseases in the jurisdiction from January 2022 to January 2024 were selected and evenly divided using a random number table. The observation group underwent big data mining management under the premise of IoT, while the reference group received conventional health management. The management effects of the two groups were compared. Results: The management indicators of the observation group were superior to those of the reference group. After management, the self-management ability scores of the observation group were higher than those of the reference group, the psychological status scores were lower than those of the reference group, and the management satisfaction was higher than that of the reference group ($P < 0.05$). Conclusion: Implementing big data mining management under the premise of IoT for high-risk individuals with chronic diseases can improve their file establishment rate, as well as the rates of early warning and screening for chronic diseases. It can also enhance the self-management ability of high-risk individuals, correct their adverse psychological conditions, and achieve high management satisfaction.

Keywords: Internet of Things; Health management of chronic diseases; Big data mining; Self-management ability; Management satisfaction

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1. Introduction

Chronic diseases are highly prevalent among middle-aged and elderly populations. Due to multiple factors such as changes in lifestyle and adjustments in dietary patterns, the onset age of chronic diseases is increasingly becoming younger, posing a significant threat to residents' health [1]. At the current stage, in the health management process for chronic diseases, information technology is actively introduced to achieve scientific and precise management, thereby improving disease prognosis. In this context, the Internet of Things (IoT) and health big data have emerged as novel means for preventing and treating chronic diseases. Continuous tracking can be achieved through services such as remote diagnosis, treatment, and follow-up management, thereby enhancing the quality of management. Under the premise of IoT, big data mining can effectively organize complex data on high-risk individuals, fully uncover hidden information, summarize scientific evidence, and subsequently carry out comprehensive health management for chronic diseases throughout the entire process, elevating their prevention and treatment standards [2]. Based on this, this study selected 188 high-risk individuals for chronic diseases to evaluate the health management effects of big data mining under the premise of IoT.

2. Materials and methods

2.1. General information

A total of 188 high-risk individuals for chronic diseases within the jurisdiction from January 2022 to January 2024 were selected and evenly divided using a random number table. The observation group consisted of 94 cases, including 52 males and 42 females, aged between 40 and 84 years old, with an average age of 56.45 ± 3.67 years. The reference group consisted of 94 cases, including 50 males and 44 females, aged between 41 and 86 years old, with an average age of 56.71 ± 3.52 years. There were no significant differences in the data between the two groups ($P > 0.05$).

Inclusion criteria: Identified as high-risk for chronic diseases during health check-ups or hospital admissions; adults; with an educational level of junior high school or above; proficient in using smartphones; with complete basic information; informed about and consenting to the study. Exclusion criteria: Accompanied by severe acute illnesses; with malignant tumors; abnormal language communication or cognitive abilities; suffering from mental disorders; withdrawing from the study midway.

2.2. Methods

The reference group underwent routine health management: Weekly knowledge lectures were organized by the hospital's outpatient department, where chronic disease educational pamphlets were distributed on-site. Chronic disease experts served as the main speakers, providing detailed explanations of disease knowledge, demonstrating self-management essentials, and informing about daily life precautions. Hospital nursing staff conducted monthly follow-up services for high-risk individuals, primarily through telephone calls, to dynamically assess their off-site management situations.

The observation group underwent big data mining management under the premise of the Internet of Things (IoT): (1) Introduction of Internet technology: The hospital's information management system was connected to community health management platforms and multi-level hospital management systems to achieve data sharing. In-depth mining of big data was conducted, enabling the IoT platform to connect with wearable medical devices or mobile internet devices. Big data was processed in an isomorphic manner through data heterogeneity, and the high-risk individuals' data, after secondary mining and processing, was statistically analyzed using the HBase database and Hadoop system framework to obtain information such as disease diagnosis results, disease progression prediction curves, and health management content. This information was then transmitted to the doctors' end, facilitating a comprehensive understanding of the high-risk individuals' chronic disease onset risks and development trends. (2) Integrated Information Network for Medical Consortiums: Integrate resources within the medical consortium, such as chronic disease equipment management and health datasets, to establish an in-hospital cloud management platform for chronic diseases. Regularly collect health status, disease diagnosis, and treatment, and healthcare information from high-risk individuals, evaluate their chronic disease management throughout the entire process, screen for risk factors in a targeted manner, and accordingly refine health management plans. (3) Combination of Online and Offline Approaches: Establish a WeChat public account for chronic disease health management and invite high-risk individuals to follow it. The public account features modules such as appointment scheduling for chronic disease check-ups and a health knowledge column. The appointment scheduling module displays information about the attending doctors' qualifications and allows for appointments to be made up to one week in advance. Three days before a follow-up visit, the WeChat public account automatically sends reminder messages, enabling high-risk individuals to make online appointments and regularly undergo chronic disease check-ups. The health knowledge column covers various aspects, including disease knowledge, treatment plans, self-monitoring, key points for daily life management, and emergency response measures. Each section includes links to articles with relevant knowledge, allowing high-risk individuals to flexibly select and learn about disease-related information. The public account sends weekly updates to high-risk individuals on sleep knowledge, healthy eating knowledge, or exercise knowledge, such as healthy recipes, sleep improvement techniques, and key points for practicing Tai Chi or yoga, encouraging them to actively learn self-management knowledge. Distribute medication knowledge to high-risk individuals through private WeChat chats, covering dosage and administration, proper storage methods, identification, and management of adverse reactions, etc. This information can be conveyed through graphic materials, animated videos, and other formats. Send mental health knowledge 2–3 times a week, utilizing animations to demonstrate meditation training techniques and mindfulness-based stress reduction methods, encouraging high-risk individuals to engage in emotional management. Organize offline expert consultation activities once a month at the outpatient department to thoroughly assess the chronic disease conditions of high-risk individuals and provide treatment recommendations from experts.

2.3. Observation indicators

Management Indicators: Evaluate the file establishment rate for high-risk populations, the rate of chronic disease early warning and screening, and other relevant indicators.

Self-Management Ability: Utilize the Health-Promoting Lifestyle Profile II (HPLP II), which includes dimensions such as health responsibility (9 items), exercise (8 items), interpersonal relations (9 items), self-actualization (9 items), nutrition (9 items), and stress management (9 items). Each item is scored from 1 to 4, with higher scores indicating better self-management ability.

Psychological Status: (1) The Mishel Uncertainty in Illness Scale-Adult (MUIS-A), consisting of 28 items, each scored from 1 to 5, with higher scores indicating greater uncertainty in illness. (2) The Self-Perceived Burden Scale (SPBS), comprising 10 items, each scored from 1 to 5, with higher scores indicating a greater sense of self-perceived burden.

Management satisfaction: A self-developed management satisfaction scale was used, encompassing communication frequency, individual guidance, etc., with a total score of 100 points. Scores exceeding 80 indicate high satisfaction, scores between 40 and 80 indicate basic satisfaction, and scores below 40 indicate dissatisfaction.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Measurement values were compared/tested using t-values, and count values were compared/tested using chi-square (x^2) values. Statistical significance was set at $P < 0.05$.

3. Results

3.1. Comparison of management indicators between the two groups

The observation group had higher rates of establishing files for high-risk populations, early warning for chronic diseases, and early screening compared to the reference group ($P < 0.05$) (**Table 1**).

Table 1. Comparison of management indicators between the two groups [n/%]

Group	Number of Cases (n)	Health Record Establishment Rate	Chronic Disease Early Warning and Screening Rate
Observation Group	94	92 (97.87)	91 (96.81)
Control Group	94	84 (89.36)	84 (89.36)
x^2-value	-	5.697	4.049
P-value	-	0.017	0.044

3.2. Comparison of self-management abilities between the two groups

The observation group scored higher in self-management ability after management compared to the reference group ($P < 0.05$) (**Table 2**).

Table 2. Comparison of self-management abilities between the two groups (Mean ± SD, points)

Group	Number of Cases (n)	Health Responsibility		Physical Exercise		Interpersonal Relationships	
		Pre-management	Post-management	Pre-management	Post-management	Pre-management	Post-management
Observation Group	94	20.15±2.97	31.75±3.19	16.87±3.18	27.15±3.52	19.78±3.11	30.47±3.61
Control Group	94	20.19±3.04	28.01±3.11	16.58±3.23	24.51±3.60	19.83±3.15	27.16±3.55
t-value	-	0.091	8.139	0.620	5.084	0.110	6.338
P-value	-	0.927	0.000	0.536	0.000	0.913	0.000
Group	**Number of Cases (n)**	**Self-Actualization**		**Nutrition**		**Stress Management**	
		Pre-management	**Post-management**	**Pre-management**	**Post-management**	**Pre-management**	**Post-management**
Observation Group	94	17.65±3.15	29.87±3.77	18.56±3.04	30.11±3.53	20.13±3.11	31.25±3.19
Control Group	94	17.61±3.20	26.04±3.71	18.59±3.06	27.05±3.42	20.19±3.14	28.01±3.14
t-value	-	0.086	7.020	0.067	6.036	0.132	7.018
P-value	-	0.931	0.000	0.946	0.000	0.895	0.000

3.3. Comparison of psychological status between the two groups

The observation group scored lower in psychological status after management compared to the reference group ($P < 0.05$) (**Table 3**).

Table 3. Comparison of psychological status between the two groups (Mean ± SD, points)

Group	Number of Cases (n)	MUIS-A (Uncertainty in Illness)		SPBS (Social Phobia)	
		Pre-management	Post-management	Pre-management	Post-management
Observation Group	94	92.16 ± 5.78	60.19 ± 4.14	41.69 ± 5.06	26.70 ± 3.11
Control Group	94	92.23 ± 5.72	71.38 ± 4.20	41.73 ± 5.09	30.29 ± 3.78
t-value	-	0.083	18.396	0.054	7.111
P-value	-	0.934	0.000	0.957	0.000

3.4. Comparison of management satisfaction between the two groups

The management satisfaction in the observation group was higher than that in the reference group ($P < 0.05$) (**Table 4**).

Table 4. Comparison of management satisfaction between the two groups [n/%]

Group	Number of Cases (n)	Very Satisfied	Satisfied	Dissatisfied	Overall Satisfaction Rate
Observation Group	94	62 (65.96)	30 (31.91)	2 (2.13)	97.87 (92/94)
Control Group	94	57 (60.64)	27 (28.72)	10 (10.64)	89.36 (84/94)
x^2-value	-	-	-	-	5.697
P-value	-	-	-	-	0.017

4. Discussion

China has a large population and vast territory, with a significant number of patients suffering from chronic diseases. The difficulty in health management poses an urgent public health issue that needs to be addressed [3]. At present, China is actively promoting a prevention and control system for chronic diseases and issuing relevant clinical guidelines. Non-invasive examinations and other means can be utilized to screen individuals at high risk for chronic diseases, providing targeted and proactive interventions to reduce the incidence of chronic diseases. However, the lack of awareness among high-risk individuals about their own conditions, inadequate coordination and cooperation among hospitals at all levels, and low participation from the entire society make it difficult to efficiently implement health management for chronic diseases [4]. Based on this, Internet of Things (IoT) technology has gradually emerged as a novel approach for chronic disease management. With its networked and digital characteristics, it can comprehensively aggregate health big data, enable resource sharing, and thereby improve the quality of health management.

IoT technology can efficiently connect multiple internet information points, dynamically assess the chronic disease status of high-risk individuals, enable early detection and treatment, and thus prevent chronic diseases. Big data mining, supported by IoT technology, can interconnect disease prevention systems within and between hospitals, share network resources while ensuring network security, and establish a cloud management platform for efficient health management of chronic diseases [5].

The results indicated that the observation group had higher rates of establishing health records for high-risk populations, rates of chronic disease early warning and screening, and scores for self-management ability compared to the reference group. Additionally, the psychological status scores were lower, and management satisfaction was higher in the observation group than in the reference group ($P < 0.05$). The analysis of the reasons is as follows: The Internet of Things (IoT) places chronic disease health management at its core, fully leveraging big data information to establish a big data management system. This system is capable of collecting and analyzing high-risk individual data through multiple channels and formats, integrating disordered and scattered data resources, and visually displaying data analysis results through software programming and other technologies. Based on this premise, management plans can be formulated to ensure management timeliness [6–7]. The IoT technology can aggregate high-risk individual data using specialized information networks and the internet as network carriers. Big data mining can then perform isomorphic processing on this data, followed by statistical analysis using data mining systems. The above process enables the collection, processing, and transmission of high-risk individual data resources, allowing for long-term storage. It possesses interconnected and intelligent characteristics, enabling dynamic tracking of chronic disease conditions in high-risk individuals, as well as intelligent identification and behavioral monitoring functions, thereby facilitating continuous management of high-risk individuals with chronic diseases [8]. Under the premise of IoT and big data mining, a combined online and offline management model for high-risk individuals can effectively guide their lifestyle and medication behaviors. Leveraging the flexibility and interactivity of WeChat official accounts, it enhances communication between nurses and patients, thereby improving management satisfaction among high-risk individuals [9]. The aforementioned management approach demonstrates high feasibility. It pays close attention to the disease conditions of high-risk individuals and provides psychological counseling to them, continuously cultivating their self-management abilities and enabling them to actively regulate their psychological states. Consequently, it yields favorable management outcomes [10].

In summary, under the premise of the Internet of Things (IoT), big data mining management can enhance the self-management capabilities and psychological well-being of individuals at high risk for chronic diseases. It encourages them to establish standardized health records and undergo regular disease screenings, thereby garnering a high level of management acceptance.

Disclosure statement

The author declares no conflict of interest.

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