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Original Article

Outcome of management based on "1+X" model in a health examination center

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Abstract: Objective: To investigate the effect of management measures based on the "1+X" model in physical examination centers. Methods: This retrospective study was conducted on 5362 individuals who underwent physical examinations in Heping Hospital Affiliated to Changzhi Medical College from January 1, 2020 to December 31, 2022. These subjects were divided into an observation group (n=2681) and a control group (n=2681) according to the different management measures. Subjects from the control group were given routine management measures, while those from the observation group were given management measures based on the "1+X" model. The scores of negative emotions, waiting time for physical examination, acquisition of health knowledge, satisfaction for the physical examinations, and efficiency and degree of credibility in medical management were evaluated and compared between the two groups. Results: After management, the scores of anxiety and depression in both groups were significantly reduced in contrast to before management, and the two scores were significantly lower in the observation group than those in the control group ($P<0.05$). The observation group experienced significantly shorter waiting time for routine urination, blood sampling, internal and surgical examinations, and electrocardiogram than the control group (all $P<0.001$). The acquisition of health knowledge in the observation group was significantly better than that in the control group ($P<0.05$). The satisfaction rates of the observation group in the terms of service attitude, examination environment, health education, and follow-up services were significantly better than those in the control group (all $P<0.05$). Moreover, the efficiency and degree of credibility in medical management in the observation group were better than those in the control group. Conclusion: The application of management measures based on the "1+X" model has a good effect in our physical examination center. On the one hand, it can significantly reduce the waiting time for various physical examinations and alleviate the negative emotions of physical examinees. On the other hand, it can effectively enhance the overall acquisition of health knowledge, the satisfaction of physical examination, and the efficiency and degree of credibility in medical management. This management model is worthy of clinical promotion and application.

Keywords: Health examination center, "1+X" mode, management for physical examinations, application effect

Introduction

In recent years, with the improvement of living standards, health awareness and changes in lifestyle and dietary habits, people's attention to their physical health has significantly increased. The concept of seeking medical treatment after diagnosis has gradually been replaced by the emerging concept of preventive health examinations [1, 2]. More and more institutions and individuals are also aware of the positive effects of physical health on work efficiency, quality of life, etc., resulting in a surge in demand for health examinations [3, 4]. Physical examination is one of the fundamental parts of hospital medical work, serving as an effective means to screen and detect diseases at early stages that may be challenging to identify. In this way, timely intervention and treatment can be conducted to prevent irreversible results caused by disease progression. Additionally, physical examination helps individuals recognize potential health risks associated with their behaviors and dietary habits, enabling timely health interventions [5, 6]. However, at present, most routine physical examinations are relatively single in content and are not in-depth, which not only wastes medical resourc-

es but also the time of the examinees. Moreover, with the increasing number of daily attendants in physical examination centers, the lack of knowledge of routine physical examinations in examinees has led to low efficiency and chaotic management procedures. At the same time, the lack of knowledge of routine physical examinations is also likely to lead to depression, anxiety and other negative emotions in individuals. These emotions may peak when abnormal indicators are detected during the physical examination, and no clear explanation is provided [7, 8]. Therefore, creating a comfortable examination environment, maintaining a well-organized examination order, developing a convenient examination process, striving for first-class service attitudes, and enhancing high-quality professional skills are important factors to improve the management of health examinations in examination centers.

The “1+X” model is a novel type of physical examination model that has gradually developed and been improved in the past years. This model can provide subjects with a more flexible, high-quality, and suitable selection of physical examination items compared to the traditional physical examination models, and it also helps individuals develop targeted physical examination plans based on their own needs [9, 10]. So far, the application of the management based on “1+X” model in physical examination has not been reported, so the effects are not clear. Therefore, in order to explore its clinical application effect, this study selected 5362 individuals who underwent health examinations in our hospital as the research subjects, and management measures based on the “1+X” model were applied, aiming to provide evidence to improve the management practices in physical examination centers.

Material and methods

General information

In this retrospective study, 5362 individuals, who underwent medical examination in physical examination center, Heping Hospital Affiliated to Changzhi Medical college from January 2020 to December 2022, were selected as research subjects. According to the management methods, these subjects were assigned into a control group and an observation group, with 2681 subjects in each group. The subjects in the observation group underwent management measures based on the “1+X” mode, while those in the control group received routine management measures. The Ethics Committee of Heping Hospital Affiliated to Changzhi Medical college approved this research (No. 2019-045).

Inclusion criteria: Individuals who received routine health examinations in Heping Hospital Affiliated to Changzhi Medical college; those were able to communicate normally; those who had complete medical data; those who were served by the same medical team during the examination.

Exclusion criteria: Individuals who were accompanied with mental or cognitive impairments; those who had poor compliance; those who had dysfunction in important organs such as kidney, heart, and liver; and those who dropped out in the middle of the study.

Methods

Subjects in the control group were given the following routine management measures: (1) Before the physical examinations, the health knowledge manual was distributed, and the entire examination process was explained. (2) During physical examination, the subjects were guided to complete the examination items strictly following the physical examination process. The relevant precautions in the physical examination process were explained. Appropriate guidance was given if the subjects had questions. (3) After physical examination, the subjects were provided with targeted health counselling based on their physical examination results.

Subjects in the observation group received the management measures based on the “1+X” model: (1) Developing a physical examination plan: Based on the clinical data, basic information, dietary and behavioral habits, occupation, family and personal medical history, a supporting physical examination plan was developed. The “1” in “1+X” mode mainly included examinations of physical features, blood lipids and glucose, routine blood work, urine and stool samples, internal medicine and surgical, facial features, abdominal color ultrasound, liver and kidney function, chest radiography and electrocardiogram. The “X” in “1+X” mode was defined

as additional special screenings based on the basic information, clinical data and related disease risk factors. 1) The targeted screening items such as tumor and mental disease screening were added for subjects with related family history. 2) Angiography, CT, or MRI examinations were provided additionally for subjects with cerebrovascular diseases. 3) Lumbar and cervical spine examinations were provided additionally for subjects who had a sedentary working style. 4) For the subjects with the family history of diabetes and hypertension, the examinations of postprandial glycosylated hemoglobin, blood sugar and other related indicators were added. 5) For middle-aged and elderly subjects, bone density and tumor indicators were examined. 6) For adult women and men, reproductive system tests were suggested, and for women of childbearing age, human papilloma virus test was added. 7) Cancer screening examinations were suggested for those who had long-term exposure to carcinogens. 8) For those with poor diet and lifestyle habits, gastrointestinal function tests such as colonoscopy and gastroscopy were added. (2) Before the physical examinations: The health knowledge manual related to the examination was distributed to all subjects, and the entire examination process was explained. At the same time, the routine examination items and additional examination items included in the “1+X” mode, as well as the necessity of all examination items were also explained. (3) During the physical examinations: All the subjects were asked to strictly follow the examination process to complete the examination items, and the relevant precautions were informed. Meanwhile, appropriate guidance was provided if the subjects had any doubts. (4) After the physical examinations: The subjects’ physical examination results were evaluated and explained, including the normal range of each examination item in the physical examination report and the possible results in case of abnormalities. For those who had significantly abnormal physical examination results, further examinations or regular reexaminations were recommended. For those with significantly abnormal physical examination results and a family history, past medical history, or risk factors of illness related to their work and life, targeted and clear health guidance was provided, and regular annual examinations were recommended.

Observation indicators

The primary indicators included adverse emotions and the acquisition of health knowledge, while the secondary ones included the waiting time for examinations, satisfaction for the physical examinations, and the efficiency and degree of credibility in medical management.

(1) Adverse emotions: The Self Rating Anxiety Scale (SAS) [11] and the Self Rating Depression Scale (SDS) [12] were used to evaluate the adverse emotions in all subjects. The cut-off value of SAS was 50 points. A score between 50 and 59 points indicated the mild anxiety, 60-69 points indicated moderate anxiety, and 70 points and greater suggested severe anxiety. The cut-off value of SDS was 53 points, with mild depression ranging from 53 to 62 points, moderate depression ranging from 63 to 72 points, and severe depression ranging from 73 points or above.

(2) The waiting time for routine urine examination, blood sampling, internal medicine and surgical examination, and electrocardiogram were calculated and compared between the two groups.

(3) The acquisition of health knowledge was compared between the two groups: According to the previous reports [13], the health knowledge acquisition scale was used for the evaluation, with a maximum score of 100 points. The results were classified as well acquired (95 points or more), aware (70-94 points), and lack of understanding (less than 70 points).

(4) Satisfaction for the physical examinations: According to a previous report [14], the physical examination satisfaction scale was used for evaluation. The scale includes four aspects, service attitude, physical examination environment, health education, and follow-up services. The total score for each aspect was 100 points, with 90 points or more for great satisfaction, 60-89 points for general satisfaction, and lower than 60 points for dissatisfaction.

(5) The efficiency and degree of credibility in medical management: According the questionnaire reported by a previous study [15], the efficiency and degree of credibility in medical management were evaluated and compared between the two groups, with a total score of

Table 1. The comparison of general information between the observation group and the control group

Parameters	Observation group (N=2681)	Control group (N=2681)	t/χ^2 value	*P* value
Sex			0.742	0.311
Male	1497	1519		
Female	1184	1162		
Age (years)	53.24±2.26	53.18±2.21	0.864	0.405
Degree of education			0.694	0.371
Junior high school and below	345	378		
Senior high school and technical secondary school	691	734		
Junior college and above	1645	1569		
Work type			3.123	0.077
Physical labor	697	641		
Mental labor	1984	2040		
Income level (CNY)			2.995	0.224
<50,000	616	670		
50,000-100,000	825	800		
>100,000	1240	1211		
Hypertension (n)	105	100	0.127	0.722
Diabetes mellitus	97	118	2.137	0.144

Note: CNY: Chinese Yuan.

Table 2. Comparison of SAS and SDS scores between the two groups (Mean ± SD, Scores)

Groups	Cases	SAS		SDS	
		Before management	After management	Before management	After management
Observation group	2681	61.33±0.27	22.25±0.30*	62.68±0.29	31.70±0.14*
Control group	2681	61.34±0.26	25.31±0.32*	62.69±0.28	33.22±0.16*
t value		1.381	361.216	1.285	370.188
P value		0.167	<0.001	0.199	<0.001

Note: SAS: Self-rating anxiety scale; SDS: Self-rating Depression Scale; Compared with before management in the same group, *P<0.05.

10 points. High score indicated better efficiency and degree of credibility in medical management.

Statistical methods

All the clinical data collected in this study were analyzed using SPSS 23.0. The measurement data were expressed as mean ± standard deviation. Paired sample t test was performed for intragroup before-after comparisons, and independent sample t test for intergroup comparisons. The count data were presented as percentages (%) or cases, and the comparison between groups was performed using χ^2 test. P<0.05 suggested a statistically significant difference.

Results

Comparison of general information

There was no significant difference in the sex, age and degree of education between the observation group and the control group (all P>0.05). Therefore, the two groups were comparable, as shown in **Table 1**.

Comparison of negative emotions between the two groups

As described in **Table 2**, there was no significant difference in SAS and SDS scores before management between the two groups. After management, the two scores were significantly

Table 3. Comparison of the waiting time for examinations between the two groups ($\bar{x}\pm s$, min)

Groups	Cases	Waiting time for routineurine	Waiting time for blood collection	Waiting time for internal medicine and surgical examinations	Waiting time for electrocardiograph
Observation group	2681	15.91±3.32	18.07±2.19	15.27±2.89	12.01±4.01
Control group	2681	24.31±2.02	23.10±2.69	19.91±3.69	18.91±3.63
t value		111.918	75.083	51.259	66.052
P value		<0.001	<0.001	<0.001	<0.001

Table 4. Comparison of the acquisition of health knowledge between the two groups [n (%)]

Groups	Cases	Well acquired	Aware	Lack of understanding
Observation group	2681	794 (29.62)	1837 (68.52)	50 (1.86)
Control group	2681	396 (14.77)	1042 (38.87)	1243 (46.36)
χ^2 value			32.128	
P value			<0.001	

reduced in both groups (all P<0.05), and the scores in the observation group were significantly lower than those in the control group (SAS: 22.25±0.30 vs. 25.31±0.32, P<0.001; SDS: 31.70±0.14 vs. 33.22±0.16, P<0.001).

Comparison of the waiting time for examinations between the two groups

As shown in **Table 3**, the waiting time for routine urine, blood collection, internal medicine and surgical examinations, and electrocardiograph in the observation group were 15.91±3.32 min, 18.07±2.19 min, 15.27±2.89 min and 12.01±4.01 min, respectively; while in control group those were 24.31±2.02 min, 23.10±2.69 min, 19.91±3.69 min and 18.91±3.63 min, respectively. The waiting time for examinations in the observation group was significant shorter than that in the control group (all P<0.001).

Comparison of the acquisition of health knowledge between the two groups

As seen in **Table 4**, among the 2681 subjects in the observation group, the health knowledge was well acquired in 794 subjects, aware in 1837 subjects, and poorly understood in 50 subjects. In the control group, the health knowledge was well acquired in 396 subjects, aware in 1042 subjects, and poorly understood in 1243 subjects. The acquisition of health knowledge in the observation group were significant better than that in the control group (P<0.001).

Comparison of degree of satisfaction for physical examinations between the two groups

As seen in **Table 5**, the satisfaction rates of service attitude, physical environment, health education and follow-up services in the observation group were 97.43%, 98.8%, 97.32%, and 96.98%, respectively, while those were 86.19%, 95.63%, 90.56%, and 89.41%, respectively, in control group. The satisfaction rates for physical examinations in the observation group were significantly better than that in the control group (all P<0.001).

Comparison of the efficiency and degree of credibility in medical management

As shown in **Figure 1**, the efficiency and degree of credibility in medical management in the control group were 5.76±0.65 and 6.91±0.79, respectively; while those were 7.61±0.98 and 8.90±1.02, respectively, in the observation group. The efficiency and degree of credibility in medical management in the observation group were significantly better than those in the control group (all P<0.001).

Discussion

Regular health examination can help individuals to find abnormal changes in the body in a timely manner, which is beneficial to conducting necessary prevention and early treatment measures, in order to treat diseases in an early stage and ensure the physical and mental health of subjects [16]. The routine health examination procedures mainly involve selecting the examination scope and items, completing the examination in different departments, conducting a comprehensive evaluation of the examination results, and providing the corresponding examination reports and health guid-

Table 5. Comparison of satisfaction for physical examinations between the two groups [n (%)]

Groups	Cases	Service attitude			Physical environment		
		Great satisfaction	General satisfaction	Dissatisfaction	Great satisfaction	General satisfaction	Dissatisfaction
Observation group	2681	1382 (51.55)	1231 (45.92)	68 (2.53)	1828 (68.18)	821 (30.62)	32 (1.20)
Control group	2681	961 (35.84)	1350 (50.35)	370 (13.81)	1528 (56.99)	1036 (38.64)	117 (4.37)
χ^2 value			14.678			9.059	
P value			<0.001			<0.001	
Groups	Cases	Health education			Follow-up services		
		Great satisfaction	General satisfaction	Dissatisfaction	Great satisfaction	General satisfaction	Dissatisfaction
Observation group	2681	1419 (52.93)	1190 (44.39)	72 (2.68)	1364 (50.88)	1236 (46.10)	81 (3.02)
Control group	2681	1193 (44.50)	1235 (46.06)	253 (9.44)	997 (37.19)	1400 (52.22)	284 (10.59)
χ^2 value			8.111			12.082	
P value			<0.001			<0.001	

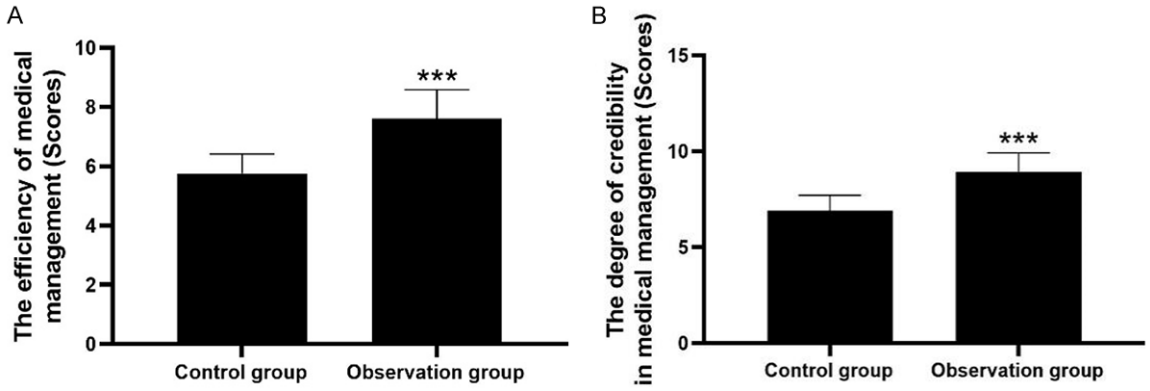

Figure 1. Comparison of the efficiency and degree of credibility in medical management between the two groups. Compared with control group, ***P<0.001. A. The efficiency of credibility in medical management between the two groups. B. The degree of credibility in medical management between the two groups.

ance. In this mode, the examination scope and items are relatively fixed, which either makes it difficult to meet the increasing disease screening needs or leads to a waste of medical resources and examination time. In addition, most individuals lack relevant health knowledge, leading to negative emotions such as anxiety and depression during the complex examination process. These factors can cause the subjects to be dissatisfied with health examinations [17]. Therefore, developing a more comprehensive and scientific physical examination mode is of great significance in alleviating the negative emotions of subjects and improving their satisfaction with physical examinations.

The “1+X” mode means that the physical examinations include “basic items” and “personalized items”. The “1” in “1+X” refers the routine physical examination items, namely, the necessary items to form personal health management files and health examination reports. This includes five parts, health examination self-test questionnaire, routine physical examinations, imaging examinations, laboratory examinations, and summary of physical examination reports. The specific items involved in routine examinations are blood, urine and stool samples, including visits with otorhinolaryngology, internal medicine, ophthalmology, gynecology, stomatology, electrocardiogram, chest X-ray, etc. [18, 19]. The “X” in “1+X” is a characteristic addition for individuals of different ages, genders, and chronic disease risks. This includes targeted special screening projects to timely identify potential risks, such as screening of tumor, cardiovascular, and cerebrovascular diseases [20]. This physical examination mode combines the basic items of routine examinations with personalized items for different populations, allowing for more flexibility in a comprehensive physical examination plan. This helps to avoid wasting excess waiting time and medical resources. It also has a certain promoting effect on improving the efficiency and quality of physical examinations.

The results of this study showed that the waiting time for routine urine examination, blood sampling, internal medicine and surgical examinations, and electrocardiogram in subjects who underwent management measures based on the “1+X” model was significantly shorter than that in those received conventional management measures. This suggested that the management based on the “1+X” model in health examination centers can significantly reduce the waiting time for various physical examinations and improve the efficiency of physical examinations. This study also found that the efficiency and degree of credibility in medical management in the observation group were better than those in control group. This may be because the management based on the “1+X” model evaluates the potential disease hazards based on the subjects’ basic information, dietary habits, occupation, family and personal medical history, in addition to routine ophthalmic, gynecological, dental and electrocardiogram examinations, and the personalized screening for related risks can minimize unneces-

sary examinations and save medical resources and examination time [21, 22].

Moreover, the results of this study also showed that the SAS and SDS scores of subjects who received the management measures based on the “1+X” model were significantly lower than those received conventional management measures. The acquisition of health knowledge and the satisfaction for physical examinations in the observation group were also better than those in control group. This suggests that the management measures based on the “1+X” model in health examination centers can strengthen the understanding of health examinations in subjects, without causing significant emotional fluctuations, which is beneficial to alleviating negative emotions and improving the satisfaction. The reasons may be that the additional “X” items in the “1+X” mode came from the risk factors of the subjects themselves. Therefore, in the process of communication and expression, it is easy for medical staff to explain and communicate with the subjects, as well as help them to accept subsequent health guidance [23, 24]. At the same time, the subjects were informed with the examination plan beforehand, so they were aware of the details and the necessity of the examinations. Real-time guidance was also provided in this mode, greatly reducing potential negative emotions and further improving the satisfaction [25, 26]. The results of this study are similar to those of a previous study [27].

In conclusions, the management measures based on the “1+X” model in our physical examination center has achieved promising results, including obviously reducing the waiting time, alleviating the negative emotions, enhancing the acquisition of health knowledge, increasing the efficiency and degree of credibility, and improving the satisfaction for physical examinations. These findings suggest that this “1+X” model is a potential valuable clinical approach for improving the management of physical examinations. However, this research still has several limitations that should be recognized. First, the sampling method may affect its findings. Second, this is a retrospective study, and there were no follow-up results. Third, the data were collected from a single center, which may affect its generalization to other hospitals.

Disclosure of conflict of interest

None.

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