

## Original Article

# Health education in the management of chronic diseases among the elderly in the community with the assistance of a Mask R-CNN model

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Received November 8, 2022; Accepted January 28, 2023; Epub July 15, 2023; Published July 30, 2023

**Abstract:** Objective: To analyze the role of health education in the management of chronic diseases in older people in the community and the countermeasures. Methods: After establishing a community health management model for chronic diseases of the elderly based on references, a prospective study was conducted on 120 elderly patients with chronic diseases registered in Xinyang Zhongxing Community Health Service Center, Xixiangtang District, Nanning City from January 2019 to June 2020. The lottery method was used to divide all patients into observation and control groups. Patients in the control group received conventional chronic disease health management, while the observation group received an additional community-based chronic disease health education model for the elderly on the basis of care given to the control group. The change in chronic disease prevention knowledge mastering, medical compliance behavior score, anxiety and depression score, and quality of life score before and after the intervention were compared. Results: After intervention, the awareness rates of patients in the observation group on the clinical manifestations, diagnostic criteria, high-risk behaviors, susceptible population and preventive measures of chronic diseases were significantly higher than that in the control group (all  $P < 0.05$ ), the scores of diet, exercise and lifestyle were significantly higher than those in the control group (all  $P < 0.05$ ), and the scores of depression and anxiety were significantly lower than those in the control group (all  $P < 0.05$ ). The scores of mental function, physical function and social function were significantly higher than those of control group (all  $P < 0.05$ ). Conclusion: Health education intervention play an important role in community management of chronic diseases in elderly patients. It effectively improves patients' understanding of the disease and enhances their compliance to medical advice, while reducing patients' anxiety, depression mood and improving their quality of life.

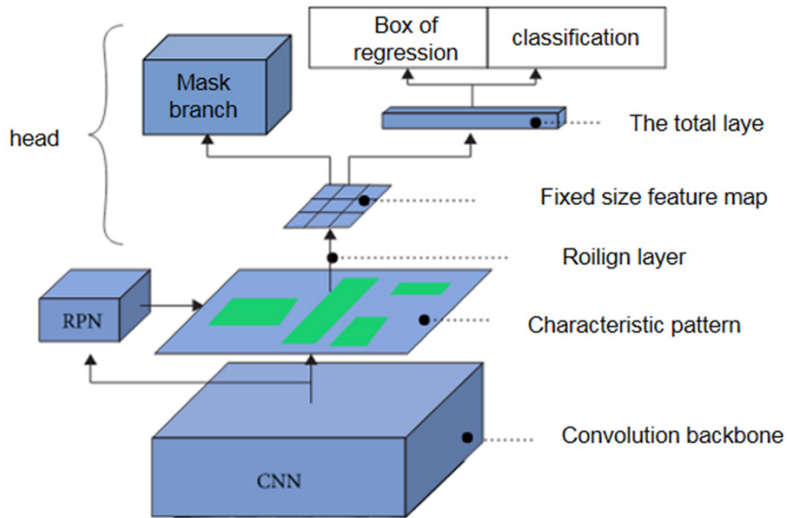
**Keywords:** Health education, community-based older people, chronic disease management, countermeasures

## Introduction

The prevalence of chronic diseases in the elderly is rising along with overall ageing. Chronic diseases have a high rate of disability and death, which seriously threaten the lives and physical health of elderly patients [1]. At present, despite the growing emphasis on the importance of health education in improving the management of chronic diseases of the elderly in the community, its implementation in the actual practice is still inadequate. Moreover, in the practice, it is easy to neglect the mental health education for the elderly. At the same

time, when the health education is carried out in our community, the team is mainly community staff who lack professional medical knowledge, so it is difficult to carry out targeted health education services. In addition, some volunteer staff are not well educated, and their knowledge of chronic diseases is limited. Thus, it is impossible to carry out certain health education for the elderly with chronic diseases. Moreover, due to the lack of relevant disease knowledge, poor living habits and weak awareness of prevention, elderly patients are prone to chronic diseases. The current priorities in the prevention and treatment of chronic diseases

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**Figure 1.** Mask Regions with convolutional neural network features (Mask R-CNN) network architecture. RPN: Region suggestion network.

are therefore improving the health knowledge of people with chronic diseases, changing their unhealthy lifestyles, lowering the likelihood of complications, and improving the quality of life, though health education can only partially improve the quality of life of people with chronic diseases [2, 3].

The community is an important activity center for the elderly; therefore, strengthening health education and management of elderly people in the community is of great significance to prevent the occurrence of chronic diseases [4]. Through the popularization of health education, the elderly can realize the importance of regular physical examination, through which they can timely understand their own physical health status, identify their own chronic diseases, and make corresponding treatment and examination. Therefore, in order to comprehensively improve the management of chronic diseases and to provide better medical service to the elderly, this study investigated the effect of community health education on chronic disease management in the elderly.

### Materials and methods

#### *Building a community health management model for elderly with chronic diseases*

Literature was reviewed to identify keyways of health management in elderly people with chronic disease. The relevant literature

published before November 2019 was searched in databases of Cochrane library, Web of science, PubMed, Proquest and Chinese biomedical literature databases including Wanfang, Weipu and China Knowledge Network. Searches were conducted using a combination of subject terms and free words, and searches by hand were used to track down relevant references when necessary. The English search terms were: (Geriatric chronic disease or Chronic disease management or Geriatric health management or Community chronic disease management or

Community health management or Primary health management education). Randomized controlled trials were evaluated by two clinical nursing graduate students according to GRADE system and the evaluation tools of JBI model of evidence-based healthcare, and self-evaluation was conducted in a mutually blind manner. Documents with different evaluation opinions were discussed until reaching consensus.

#### *Constructing a model for chronic disease health education for older people in the community*

(1) Mask Regions with convolutional neural network features (Mask R-CNN) construction: Mask R-CNN is derived from Faster R-CNN by adding a branch to predict the object Mask alongside the existing bounding box recognition branch. Mask R-CNN is easier to train and less expensive than Faster R-CNN, which is suitable for prediction of chronic diseases in older age. **Figure 1** depicts the Mask R-CNN model architecture.

(2) Backbone is a collection of feature maps that convolutional layers like VGG16, VGG19, GooLeNet, ResNet50, and ResNet101 have collected from images. The gradient disappearance and explosion issues brought on by the network's increasing depth are successfully resolved by the suggested ResNet (deep residual network). As demonstrated in **Figure 2**, two different types of blocks (Identity blocks and

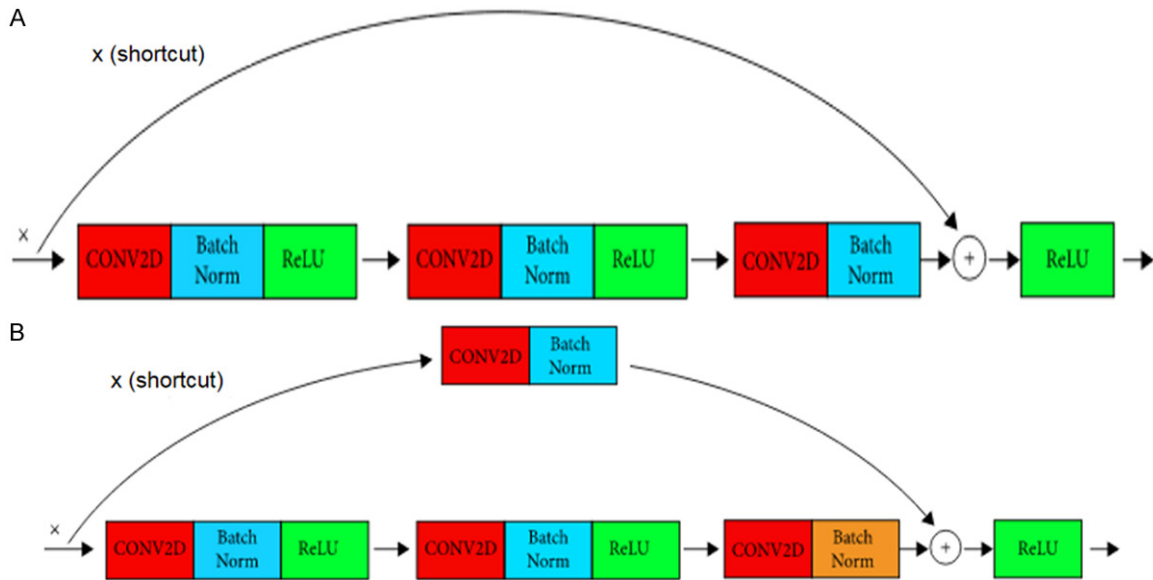


Figure 2. ResNet framework based on Identity block and Conv block. A: Identity block; B: Conv block.

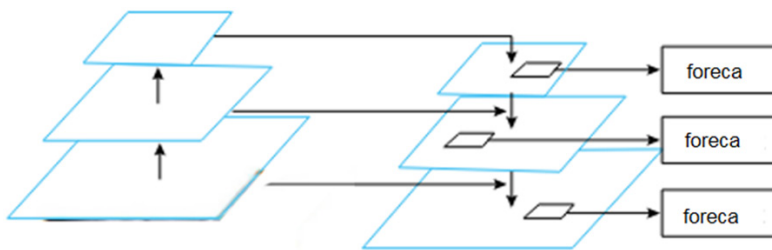


Figure 3. FPN feature extraction process. FPN: Feature Pyramid Network.

Conv blocks) can be utilized interchangeably when creating a ResNet.

(3) Feature Pyramid Network (FPN): FPN can separate objects of variable sizes and features of objects, using shallow and deep features to separate simple versus responsible objects. The basic concept is to use the properties of the convolutional network itself to apply convolution and pooling manipulation to images to obtain feature maps of variable sizes. The shallow network emphasizes detail and the deep network stresses semantic messages in order to facilitate the feature extraction of chronic diseases in the elderly. The process of extracting features for the FPN is depicted in **Figure 3**.

(4) Region suggestion network (RPN): RPN outputs various types of rectangular object boxes with scores as input through images of any scale. After inputting characteristics of chronic

elderly diseases, it provides regional suggestions according to the main health management methods of elderly patients with chronic diseases. The schema is presented in **Figure 4**.

RPN achieves gliding wid-gets to address the windows on the shared  $N \times N$  recon-

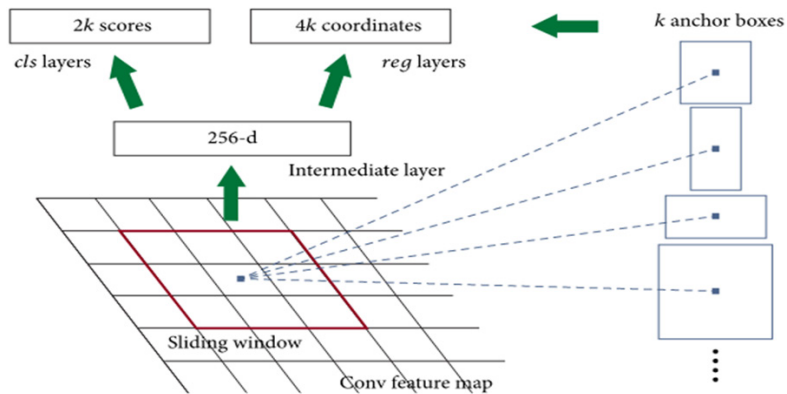
volution layer output of the feature map. In terms of each sliding widow, multiple region proposal, i.e.,  $K$  anchor box, is realized, with each anchor box corresponding to one anchor point. For a volume map of dimensions  $W \times H$ , there are a grand total of  $W \times H \times K$  anchor points.

The risk factor of the RPN system is determined as follows:

$$L(\{p_i\}, \{t_i\}) = \frac{1}{N_{cls}} \sum_i L_{cls}(p_i, p_i^*) + \lambda \frac{1}{N_{reg}} \sum_i p_i^* L_{reg}(t_i, t_i^*)$$

With the index where  $i$  is the mass anchor points. The forecast prediction probability that corresponds to each of the anchor points, denotes the ground truth (GT) label of the formation set, and the vehicle that represents the parameterization coordinates of the anchor box

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**Figure 4.** The RPN architecture. RPN: Region suggestion Network.

is the corresponding vector of the GT bounding box.

### *Clinical model validation*

**General data:** This prospective study included 120 elderly patients with chronic diseases who were registered at Xinyang Zhongxing Community Health Service Centre, Xixiangtang District, Nanning City, Guangxi Zhuang Autonomous Region from January 2019 to June 2020. Among them, there were 76 male patients and 44 female patients. All patients were divided into observation group and control group according to the lottery method, with 60 cases in each group. The study was approved by the ethics committee of Xinyang Zhongxing Community Health Service Centre.

**Inclusion criteria:** (1) Patients meeting the diagnostic criteria for chronic diseases [5]. (2) Patients with an age of 55-80. (3) Patients with complete clinical information. (4) Patients and their family members who had given informed consent.

**Exclusion criteria:** (1) Patients with psychiatric disorders who were cognitively incompetent. (2) Patients with severe illness (advanced disease, total loss of function, etc.). (3) Patients who were unable to receive all kinds of information normally.

### *Research methodology*

The control group of patients received the conventional health management approach for chronic disease. The patients received regular follow-up visits and routine medical treatment, and were given information on health educa-

tion and self-health management. On the basis of the control group, the observation group was applied with the community health education model for chronic diseases of the elderly, in combination with the internet + blood pressure and blood glucose monitoring and management system. The system directly uploaded the blood pressure and blood glucose data measured at home to the health education model, and the commu-

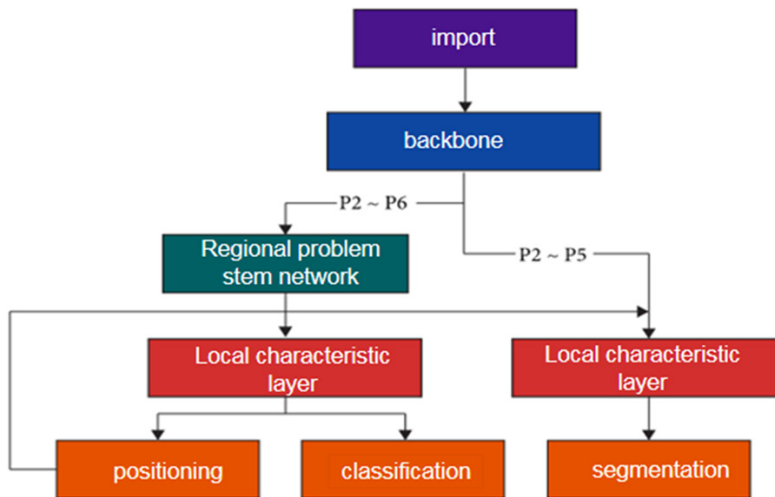
nity doctors could conduct supervision and management and medication guidance according to the output data results of the model. Community volunteers would provide a free diagnosis every two weeks. The medical and nursing joint team explained the knowledge of chronic diseases such as hypertension, diabetes and coronary heart disease by means of animation, PPT and video. Meanwhile, physical examination was provided to patients and the data were input into the model. The two groups were intervened upon for a total of six months.

### *Observed indicators*

(1) The knowledge on prevention and treatment of chronic diseases in both groups: A self-made questionnaire was used to understand the knowledge of patients with chronic disease on disease prevention and control before and after the intervention. The questionnaire included five dimensions, namely clinical manifestations, diagnostic criteria, high-risk behaviors, susceptible groups and preventive and control measures. The total score of each dimension is 60 points. Cronbach's coefficient is commonly used for assessing the reliability of the questionnaire, with Cronbach's  $>0.7$  of high reliability. The Cronbach's of the items in this questionnaire was 0.814, indicating a high degree of consistency among items in the questionnaire. Questionnaire validity was analyzed by content validity evaluation.

(2) Compliance behavior: To assess the change in patients' compliance behavior before and after the intervention, a self-designed questionnaire was applied, including 3 dimensions of diet, exercise and lifestyle. There are 10 entries, each with 5 levels: never (2 points), rarely (4 points), sometimes (6 points), often (8

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**Figure 5.** Chronic disease health management model for older people in the community.

points) and always (10 points), for a total of 100 points. The Cronbach's coefficient for questionnaire reliability was 0.793, indicating a high degree of consistency within the questionnaire. Content validity assessment was taken for questionnaire validity analysis.

(3) Anxiety and depression: Self-rating Anxiety Scale (SAS) [6] was applied to measure patients' subjective feelings about their tendency to anxiety. The scale contains 20 items, in which 5 items are scored in reverse. Each item is graded according to the frequency of symptoms, with 1 being never, 2 being sometimes, 3 being often, and 4 being always. The total score ranges from 25 to 100 with a score <50 indicating no anxiety, 50-60 indicating mild anxiety, 61-70 indicating moderate anxiety and >70 indicating severe anxiety. Hamilton Depression Inventory (HAMD) [7] was applied to measure patients' subjective feelings about their tendency to depression. The scale has a total of 24 items covering seven dimensions: anxiety/somatization (6 items), weight loss (1 item), cognitive impairment (6 items), circadian change (1 item), block/delay (4 items), sleep disturbance (3 items) and hopelessness (3 items). A total score  $\leq 7$  indicates no depression, 8-17 indicates mild depression, 18-24 indicates moderate depression and >24 indicates major depression.

(4) Quality of life: The Quality-of-Life Instruments for Chronic Diseases-General Module (QLICD-

GM) was employed to measure the quality of life of patients with chronic disease in three dimensions: psychological, physical and social [8]. There are 30 items in total, with each item scored according to a 5-point scale: 1- not at all, 2-a little, 3-some times, 4-often, and 5-always. The total score ranges from 30 to 150, with higher scores indicating better quality of life.

The changes of relevant indexes of all subjects were observed for half a year after intervention.

### Statistical methods

The data were analyzed using SPSS 22.0. The measurement data were examined for normality, and those conforming to normal distribution were expressed as  $\bar{x} \pm sd$ , and compared using student t-test between two groups. The categorical data were expressed as percentage (%) and compared between groups using the  $\chi^2$  test. A statistical difference was defined as  $P < 0.05$ .

### Results

#### Construction of chronic disease health management model for older people in the community

The input senile chronic illnesses were handled by RPN and characteristic layers to discriminate the targets. The derived P2-P5 were used as four pieces of input to the RPN, in which various sizes of ancillary boxes were constructed, and the regions were predicted to possess the specific probability of incorporating a specified object based on the intersection ratio of the prediction box to the target box, thus discriminating the geriatric chronic diseases. As there were different types of clinical conditions to be recognized, RPN was used. After acquiring different regions by RPN, the backbone network would input the results to the extracted P2-P6 and identify which floor to map to based on the magnitude of the interested region. See **Figure 5**.

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**Table 1.** Comparison of the general data between the two groups

		Control group (n=60)	Observation group (n=60)	$\chi^2/T$	P
Gender	male	37 (61.67)	39 (65.00)	0.144	0.705
	female	23 (38.33)	21 (35.00)		
Mean age ( $\bar{x} \pm s$ , year)		68.28±4.36	67.94±4.15	0.438	0.663
Mean duration of disease ( $\bar{x} \pm s$ , year)		7.56±3.68	7.45±3.52	0.167	0.867
Category of chronic diseases (%)	Hypertension	24 (40.00)	26 (43.33)	0.137	0.711
	Diabetes	19 (31.67)	18 (30.00)	0.039	0.843
	Coronary heart disease	14 (23.33)	11 (18.33)	0.455	0.500
	Cardiac insufficiency	11 (18.33)	13 (21.67)	0.208	0.648
	Rheumatoid arthritis	9 (15.00)	8 (13.33)	0.069	0.794
	Lumbar spine lesions	2 (3.33)	3 (5.00)	0.000	1.000
Complications of chronic diseases (%)	Single chronic disease	41 (68.33)	43 (71.67)	0.159	0.690
	Associated with multiple chronic diseases	19 (31.67)	17 (28.33)		

Note:  $\chi^2$  test was used to compare the gender, category of chronic diseases and the combination of chronic diseases between the two groups, and t-test was used to compare the age and course of disease between the two groups.

### Comparison of the general data between the two groups

The ratio of male to female in the control group was 37:23. The mean age of patients in the control group was (68.28±4.36) and the mean duration of disease was (7.56±3.68) years. There were 24 cases of hypertension, 19 cases of diabetes, 14 cases of coronary heart disease, 11 cases of cardiac insufficiency, 9 cases of rheumatoid arthritis, and 2 cases of lumbar lesions. There were 41 cases with single chronic disease and 19 cases with multiple chronic diseases.

The ratio of male to female in observation group was 39:21. The mean age of patients in the observation group was (67.94±4.15) and the mean duration of disease was (7.45±3.52) years. There were 26 cases of hypertension, 18 cases of diabetes, 11 cases of coronary heart disease, 13 cases of cardiac insufficiency, 8 cases of rheumatoid arthritis, and 3 cases of lumbar lesions. There were 43 cases with single chronic disease and 17 cases with multiple chronic diseases. The general data of the two groups were compared, and the difference was not significant ( $P>0.05$ , **Table 1**).

### Comparison of the knowledge about chronic disease between the two groups

Before the intervention, the difference between the two groups was insignificant ( $P>0.05$ ). After the intervention, the mastering degree of knowledge about the clinical manifestations,

diagnostic criteria, high-risk behaviors, vulnerable population and prevention and control measures of chronic diseases were 95.00%, 76.67%, 88.33%, 91.67% and 93.33% respectively in the observation group, which were significantly higher than those of the control group (all  $P<0.05$ , **Table 2**).

### Comparison of patients' compliance behavior between the two groups

Before the intervention, the difference in compliance behavior between the two groups was insignificant ( $P>0.05$ ). After the intervention, patients in the observation group had significantly higher diet score (27.16±3.28), exercise score (30.14±3.26) and lifestyle score (34.71±3.71) than those of the control group (all  $P<0.05$ , **Table 3**).

### Comparison of anxiety and depression status between the two groups

Before the interference, the differences in depression and anxiety scores between the two groups were insignificant (both  $P>0.05$ ). After the intervention, the depression score (12.27±3.53) and anxiety score (53.26±6.93) were significantly lower in the observation group (all  $P<0.05$ , **Table 4**).

### Comparison of patients' quality of life score between the two groups

Before the intervention, the difference in quality of life between the two groups was insignifi-

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**Table 2.** Comparison of the mastering rate of knowledge about chronic disease prevention and control between the two groups (%)

Indicators	Control group (n=60)	Observation group (n=60)	$\chi^2$	P
Clinical Presentation				
Pre-intervention	14 (23.33)	16 (26.67)	0.178	0.673
Post-intervention	41 (68.33)*	57 (95.00)*	14.249	0.000
Diagnostic criteria				
Pre-intervention	11 (18.33)	12 (20.00)	0.054	0.817
Post-intervention	35 (58.33)*	46 (76.67)*	4.596	0.032
High Risk Behavior				
Pre-intervention	15 (25.00)	14 (23.33)	0.046	0.831
Post-intervention	41 (68.33)	53 (88.33)*	7.070	0.008
Vulnerable population				
Pre-intervention	12 (20.00)	13 (21.67)	0.051	0.822
Post-intervention	31 (51.67)*	55 (91.67)*	23.629	0.000
Prevention and treatment measures				
Pre-intervention	18 (30.00)	20 (33.33)	0.433	0.510
Post-intervention	48 (80.00)*	56 (93.33)*	4.615	0.032

Note: \*P < 0.05, compared with pre-intervention.

**Table 3.** Comparison of compliance score between the two groups ( $\bar{x} \pm sd$ )

Dimensionality	Control group (n=60)	Observation group (n=60)	T	P
Diet				
Pre-intervention	18.24±3.66	17.96±3.42	0.433	0.666
Post-intervention	23.42±3.21*	27.16±3.28*	6.312	0.000
Movement				
Pre-intervention	19.33±3.97	19.52±4.02	0.261	0.795
Post-intervention	28.17±3.19*	30.14±3.26*	3.346	0.001
Lifestyle				
Pre-intervention	21.27±6.28	21.18±6.31	0.078	0.938
Post-intervention	32.55±3.62*	34.71±3.71*	3.228	0.002

Note: \*P < 0.05, compared with before intervention.

**Table 4.** Comparison of anxiety and depression scores between the two groups ( $\bar{x} \pm sd$ )

Dimension	Control group (n=60)	Observation group (n=60)	T	P
Depression score				
Pre-intervention	20.35±6.14	20.44±6.31	0.079	0.937
Post-intervention	13.68±3.22	12.27±3.53	2.286	0.024
T	7.452	13.245	-	-
P	0.000	0.000	-	-
Anxiety score				
Pre-intervention	68.25±6.29	68.19±6.34	0.052	0.959
Post-intervention	57.37±6.76	53.26±6.93	3.289	0.001
T	9.127	12.313	-	-
P	0.000	0.000	-	-

cant (P > 0.05). After the intervention, the psychological functioning (85.66±17.46), physical

functioning (85.47±16.19) and social functioning (79.37±17.15) scores of the patients in the

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**Table 5.** Comparison of quality of life scores between the two groups ( $\bar{x} \pm sd$ )

Dimensionality	Control group (n=60)	Observation group (n=60)	T	P
Psychological functions				
Pre-intervention	60.29±16.35	60.34±15.82	0.017	0.986
Post-intervention	77.69±17.21*	85.66±17.46*	2.518	0.013
Physiological functions				
Pre-intervention	71.52±18.11	71.23±17.94	0.088	0.930
Post-intervention	79.38±16.72*	85.47±16.19*	2.027	0.045
Social functions				
Pre-intervention	65.33±17.29	65.76±17.34	0.136	0.892
Post-intervention	72.28±16.84*	79.37±17.15*	2.285	0.024

Note: \*P<0.05, compared with pre-intervention.

observation group were significantly higher than those of the control group (all P<0.05, Table 5).

### Discussion

In recent years, with the aggravation of aging, the number of people with chronic diseases in China is on the rise, annually [9]. The community is an important activity center for the elderly, and survey results show that the co-occurrence of chronic diseases among the elderly in the community in China is over 55%, with nearly 30% of patients suffering from three or more chronic diseases at the same time [10, 11]. If not intervened in a timely manner, they can lead to a variety of complications that threaten the lives of the elderly. Currently, clinical guidelines for single chronic diseases are more common and there is a lack of relevant guidelines on the co-existent chronic diseases. Due to the long and recurrent course a smooth transition from hospital care to community-based rehabilitation for the elderly with chronic diseases is essential [12]. In some communities, elderly people with chronic cases cannot receive timely and effective health management due to geographical, economic or cultural influences, and their quality of life is not effectively improved [13, 14]. However, community health care is the grassroot of chronic disease management, and with the gradual implementation of community management, the quality of care in the community has been improved overall [15].

Health education on chronic diseases for the elderly in the community plays an important role in improving the health awareness and health level of the elderly. Through participato-

ry training activities for the elderly in the community; on one hand, the elderly are able to relax physically and mentally, on the other hand, they can learn health knowledge and scientific prevention and treatment of chronic diseases, master health skills and understand that a healthy body is shaped by oneself [16, 17]. The Medium- and Long-term Plan for the Prevention and Control of Chronic Diseases in China (2017-2025) [18] proposes to adhere to prevention-based approaches, strengthen early detection and screening of diseases, and promote the shift from disease treatment to health management. The Outline of the 14th Five-Year Plan for National Economic and Social Development and Vision 2035 proposes to strengthen the construction of primary health care teams, with emphasis on urban communities and rural grassroots, border crossing cities and county hospitals, and to improve the urban and rural health care service network [19]. In accordance with the national strategy, this study concentrated on community-based health education for older people with chronic conditions.

Li Yan et al [20] found in their retrospective analysis of the effect of health education on the lifestyle management of chronic diseases in elderly communities that the knowledge mastery rate, disease awareness rate, good lifestyle rate, blood sugar, blood fat, blood pressure up to the standard rate and non-drug treatment awareness rate were significantly improved after health education intervention. The proportion of patients with regular medication, self-blood pressure monitoring, scientific exercise and reasonable diet increased significantly, and the incidence of complications also



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decreased significantly. It shows that health education has a good effect in the community for elderly chronic disease lifestyle management. In this study, we reviewed the literature to identify the main health management methods for elderly patients with chronic diseases, established a chronic disease health management model, developed targeted management measures according to the characteristics of the chronic diseases, and carried out long-term follow-up to promote the improvement of the management and control rate of chronic diseases.

The results of the study showed that patients with health education intervention had a significantly higher awareness of clinical manifestations, diagnostic criteria, high-risk behaviors, vulnerable population and prevention and control measures of chronic diseases, indicating that the implementation of health education in this model is feasible and effective in increasing patients' awareness of the disease. We also found that after intervention, patients in the intervention group had statistically higher diet scores, exercise scores and lifestyle scores than the control group, which is consistent with the findings of Yuan et al. [21]. This indicates that the health education approach can effectively improve the patients' awareness of the disease, thus improve their compliance. Moreover, this study showed that after chronic disease health education, the anxiety and depression scores in the observation group decreased significantly, with significantly lower scores than the control group. It was also found that after the intervention, the psychological function scores, physical function scores and social function scores of the patients in the observation group were significantly higher than those of the control group. The reason may be that the health management model provided the patients a targeted health education program after analyzing their illnesses, and the patients' awareness of the illnesses and understanding of the precautions for the illnesses were improved, thus reducing their psychological burden, decreasing their anxiety and depression and improving the quality of life of patients.

In summary, health education interventions have an important role in the management of elderly patients with chronic diseases in the community. It enhances patients' awareness of

the disease and improves their compliance with medical advice, which in turn alleviates their anxiety, depression and improved quality of life to some extent. However, this study has not yet conducted long-term follow-up and is still a basic clinical study, so further experiments need to be done at a later stage.

### Disclosure of conflict of interest

None.

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