# Study on the Effectiveness of "Three-Specialist Co-management" Family Doctor Contract Service in Health Management for Elderly Hypertensive Patients (Post-print)

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## Abstract

Background: Since 2014, Xiamen has innovatively implemented a "Three-in-One Co-management" family doctor contract service model for chronic diseases such as hypertension, providing patients with integrated continuous services encompassing "prevention, screening, treatment, management, education, and rehabilitation,"which has improved service quality, promoted harmonious doctor-patient relationships, and enhanced patients' sense of gain. However, research on the application effects of this model is currently lacking.

Objective: To understand the health management effectiveness of the "Three-in-One Co-management" family doctor contract service for elderly hypertensive patients, analyze factors influencing patients'blood pressure control, and provide references for continuously improving the health management effectiveness of this service model.

Methods: A retrospective cohort study design was adopted. In March 2024, hypertensive patients aged $ $65 years who first participated in family doctor contract services in 2021 and continuously received such services for 2 years were selected as the contracted group (n=15,154) from six districts under Xiamen' s jurisdiction. Patients aged $ $65 years who had never participated in family doctor contract services were selected as the non-contracted group (n=8,838). Patients' general demographic information, lifestyle information, disease status, and medication usage were collected through the Xiamen Basic Public Health Cloud Platform. Participation in family doctor contract services was matched through the "Xiamen iHealth" platform. Physical examination results were collected through the Xiamen Elderly Health Examination Data Platform. Blood pressure control status, physical examination results, lifestyle,

and medication adherence were compared and analyzed between the contracted and non-contracted groups in 2021 (baseline) and 2023. Multivariate logistic regression analysis was used to examine the impact of family doctor contract services on patients' blood pressure control.

Results: The blood pressure control rate in the contracted group increased from 60.10% (9,108/15,154) in 2021 to 76.78% (11,635/15,154) in 2023, with a statistically significant difference between the two years (P=0.010). The blood pressure control rate in the non-contracted group increased from 62.24% (5,501/8,838) in 2021 to 68.61% (6,064/8,838) in 2023, with no statistically significant difference between the two years (P=0.298). The decreases in left-arm diastolic blood pressure and right-arm systolic blood pressure in the contracted group in 2023 compared with 2021 were greater than those in the non-contracted group (P<0.05). The BMI distribution and the incidence rates of central obesity, elevated fasting blood glucose, and abnormal electrocardiogram findings in the contracted group in 2023 improved compared with 2021 (P<0.05). Exercise status and medication adherence also improved compared with 2021 (P<0.05). Multivariate logistic regression analysis showed that the blood glucose control achievement rate in patients who contracted family doctors was 1.625 times that of non-contracted patients (95% CI=1.536–1.719).

Conclusion: The "Three-in-One Co-management" family doctor contract service plays a positive role in blood pressure control among elderly hypertensive patients. Under the intervention of the family doctor team, patients receive more refined and individualized whole-course health management, their lifestyles are improved, service adherence is higher, and hypertension control rates are better.

## Full Text

# The Health Management Effect of "Three-Teacher Joint Management" Family Doctor Contracted Services on Elderly Hypertensive Patients in Xiamen City

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### Abstract

**Background:** Since 2014, Xiamen City has innovatively implemented the "Three-Teacher Joint Management" family doctor contracted service model, using chronic diseases such as hypertension as an entry point. This model provides patients with integrated continuous services encompassing prevention, screening,

treatment, management, education, and rehabilitation, thereby improving service quality, promoting doctor-patient harmony, and enhancing patients' sense of gain. However, systematic research on the effectiveness of this model remains limited.

**Objective:** To evaluate the health management effectiveness of the "Three-Teacher Joint Management" family doctor contracted service for elderly hypertensive patients, analyze factors influencing blood pressure control, and provide evidence for continuously improving this service model.

**Methods:** A retrospective cohort study was conducted in March 2024. Elderly hypertensive patients ($ $65 years) who first enrolled in family doctor contracted services in 2021 and continuously received services for two years across six administrative districts of Xiamen were selected as the contracted group (n=15,154). Patients who never participated in family doctor contracted services were selected as the non-contracted group (n=8,838). General demographic information, lifestyle data, disease status, and medication use were collected through the Xiamen Basic Public Health Cloud Platform. Participation in family doctor contracted services was matched through the "Xiamen iHealth" platform, and physical examination results were obtained from the Xiamen Elderly Health Examination Data Platform. Blood pressure control, examination results, lifestyle factors, and medication adherence were compared between the contracted and non-contracted groups for 2021 (baseline) and 2023. Multivariate logistic regression analysis was used to examine the impact of family doctor contracted services on blood pressure control.

**Results:** The blood pressure control rate in the contracted group increased from 60.10% (9,108/15,154) in 2021 to 76.78% (11,635/15,154) in 2023, a statistically significant improvement (P=0.010). In contrast, the non-contracted group's control rate increased from 62.24% (5,501/8,838) to 68.61% (6,064/8,838), which was not statistically significant (P=0.298). The contracted group showed significantly greater reductions in left diastolic blood pressure and right systolic blood pressure compared to the non-contracted group (P<0.05). Additionally, the contracted group demonstrated improvements in BMI distribution, central obesity prevalence, elevated fasting blood glucose rates, and abnormal electrocardiogram findings between 2021 and 2023 (P<0.05), along with improved exercise patterns and medication adherence (P<0.05). Multivariate logistic regression revealed that contracted patients had 1.625 times higher odds of achieving blood pressure control than non-contracted patients (95%CI=1.536–1.719).

**Conclusion:** The "Three-Teacher Joint Management" family doctor contracted service plays a positive role in blood pressure control among elderly hypertensive patients. Under the intervention of family doctor teams, patients receive more refined and individualized comprehensive health management, leading to improved lifestyles, higher service compliance, and better hypertension control rates.

**Keywords:** Family doctor contracted services; Hypertension; Health manage-

ment; Community health services; Blood pressure control; Xiamen

## Introduction

China' s population aging is becoming increasingly severe, with the proportion of individuals aged $ $65 years projected to exceed 25% by 2050 [1]. Among the elderly, the prevalence of chronic diseases remains high, with hypertension affecting 53.2% of Chinese adults aged $ $60 years—significantly higher than in younger populations [2]. The National Essential Public Health Services Program has designated hypertension management as a key service component [3]. Building upon this foundation, the promotion of family doctor contracted services can provide hypertensive patients with more comprehensive and continuous health management, helping them control blood pressure and improve quality of life [4].

Xiamen' s "Three-Teacher Joint Management" family doctor contracted service model strengthens collaboration between specialists and general practitioners, breaking down barriers between different levels of medical institutions. This approach emphasizes team integration, professional diagnosis and treatment, and service continuity, effectively improving primary care quality and attracting chronic disease patients—particularly those with hypertension—to seek care at community health facilities. Supported by information technology, the model has established an interactive communication platform between doctors and patients, providing convenient integrated services including prevention, screening, treatment, health education, management, and rehabilitation. This has substantially improved primary care efficiency, met patients' personalized treatment needs, and enhanced their sense of gain. Having operated for a decade, the model' s population health management effects have not yet been systematically evaluated. This study focuses on elderly hypertensive patients to analyze the specific application effectiveness of the "Three-Teacher Joint Management" model in this population, evaluate its health management outcomes, and provide evidence for further advancing and refining the service model.

## Methods

### Study Design and Participants

This retrospective cohort study was conducted in March 2024. Participants were selected from 39 communities across six administrative districts in Xiamen, which had a total resident population of 5.327 million at the end of 2023, including 367,000 individuals aged $ $65 years. Among them, 305,300 elderly individuals participated in health examinations, 132,300 had diagnosed hypertension, 328,700 received essential public health services, and 285,100 participated in family doctor contracted services.

The contracted group (n=15,154) comprised elderly hypertensive patients who

first enrolled in family doctor contracted services in 2021, continuously received services for two years, and underwent annual health examinations. The non-contracted group (n=8,838) consisted of elderly hypertensive patients who never participated in family doctor contracted services but received annual health examinations.

**Inclusion criteria:** (1) Met the diagnostic criteria for hypertension in the *National Guidelines for Primary Hypertension Prevention and Management* (systolic blood pressure $ $140 mmHg or diastolic blood pressure $ $90 mmHg, or previous hypertension diagnosis) [3]; (2) Age $ $65 years with complete self-care ability.

**Exclusion criteria:** (1) Severe underlying diseases, serious acute or chronic complications, or other conditions threatening quality of life; (2) Cognitive impairment or severe mental disorders; (3) Bedridden or with mobility limitations; (4) Recent surgery, trauma, or major illness history; (5) Missing key indicator data.

### The "Three-Teacher Joint Management" Family Doctor Contracted Service Model

The "Three-Teacher Joint Management" model is patient-centered and demand-oriented, strengthening collaboration between general practitioners and specialists. The team consists of hospital specialists, community general practitioners, and health managers who provide integrated care. For hypertensive patients, the management includes: (1) Using Xiamen' s primary healthcare cloud platform to triage newly diagnosed hypertensive patients into red, yellow, and green categories for tiered management intensity, with real-time escalation when conditions change and possible de-escalation after completing at least one management cycle, while intervening on unhealthy lifestyles and implementing health education; (2) Establishing a "1+1+N" contracted service model that provides personalized health management, "long prescription" medication services, priority specialist appointment booking, routine follow-up, health consultation, and medication guidance through a smartphone APP, promoting integration between general and specialized care to enhance service quality.

The annual contracted service fee is 120 RMB per person, with individuals, medical insurance, and government funding contributing 20, 70, and 30 RMB respectively. Patients must use their medical insurance card for real-name internet contracting to formally enroll (or renew) in family doctor services and access "Internet+" team-based care. The service employs information management through the "Xiamen iHealth" platform for quality control, requiring health records with associated medical documentation and/or service records and health education compliant with service specifications. The contract is valid for one year, with renewal reminders automatically sent to residents before expiration [5].

### Data Collection and Indicator Definitions

General demographic information, hypertension status, lifestyle factors, medication use, and management service data were collected through the Xiamen Basic Public Health Cloud Platform. Participation in family doctor contracted services was matched via the "Xiamen iHealth" platform, and physical examination results were obtained from the Xiamen Elderly Health Examination Data Platform.

The *National Essential Public Health Services Specifications (Third Edition)* requires primary healthcare institutions to provide annual physical examinations for elderly residents aged $ $65 years [5]. Xiamen' s primary healthcare institutions are equipped with standardized testing equipment with uniform parameters and reference ranges. All test results must be automatically imported into the elderly health examination data platform; manual entry is prohibited. Primary healthcare institutions establish partnerships with secondary or higher-level hospitals within their jurisdiction, strengthening work coordination and data connectivity. District health administrative departments are responsible for qualification review, supervision, and quality control of medical institutions conducting elderly health examinations.

**Diagnostic criteria:** (1) Blood pressure control: measured on-site during health examination, defined as diastolic <90 mmHg and systolic <140 mmHg [6]; (2) BMI: <18.5 kg/m$^2$ as underweight, 18.5–23.9 kg/m$^2$ as normal, 24.0–27.9 kg/m$^2$ as overweight, $ 28.0$kg/m\^{}\{2\}$ as obese; (3) Central obesity: waist-to-height ratio (WHtR) $ $0.5; (4) Elevated fasting blood glucose: $ $7.0 mmol/L; (5) Dyslipidemia: total cholesterol $ $5.18 mmol/L, triglycerides $ $1.7 mmol/L, HDL-C $ $1.04 mmol/L, or LDL-C $ $3.37 mmol/L; (6) Liver dysfunction: ALT $ $40 U/L and/or AST $ $40 U/L$; (7) $Kidneydysfunction$ : $uricacid > 420mmol/Linmenor > 350mmol/Linwomen, orcreatinine > 115mmol/Linmenor > 97mmol/Linwomen$; (8) $Bloodroutineabnormalities$ : $whitebloodcells < 4.0\times10^{\{9\}/Lor > 10.0\times10}\{9\}/L, hemoglobin < 120g/Lor > 160g/Linmenor < 110g/Lor > 150g/Linwomen, orplatelets < 100\times10^{\{9\}/Lor > 300\times10}\{9\}$/L; (9) Urine routine abnormalities: positive urine glucose, ketone bodies, protein, or occult blood; (10) Electrocardiogram and abdominal ultrasound abnormalities were diagnosed according to national standards, with any parameter outside reference ranges considered abnormal [7-8].

### Statistical Analysis

SPSS 22.0 software was used for data analysis. Categorical data were expressed as percentages and compared using $^2$ tests. Normally distributed continuous data were expressed as mean ± standard deviation ($\bar{x}\pm s$), with paired t-tests for within-group comparisons and independent samples t-tests for between-group comparisons. Non-normally distributed continuous data were expressed as median (P25, P75) and compared using Wilcoxon rank-sum tests. Logistic regression analysis was used to identify influencing factors. Statistical significance

was defined as P<0.05.

## Results

### Comparison of General Demographic Information

The contracted group (n=15,154) included 6,396 men (42.21%) and 8,758 women (57.79%), with age distribution: 6,058 (39.98%) aged 65–69 years, 4,328 (28.56%) aged 70–74 years, 2,688 (17.74%) aged 75–79 years, 1,364 (9.00%) aged 80–84 years, 585 (3.86%) aged 85–89 years, and 131 (0.86%) aged $ $90 years. Marital status: 13,304 (87.79%) married, 1,850 (12.21%) unmarried/divorced/widowed.

The non-contracted group (n=8,838) included 4,019 men (45.47%) and 4,819 women (54.53%), with age distribution: 3,090 (34.96%) aged 65–69 years, 2,539 (28.73%) aged 70–74 years, 1,651 (18.68%) aged 75–79 years, 938 (10.61%) aged 80–84 years, 464 (5.25%) aged 85–89 years, and 156 (1.77%) aged $ $90 years. Marital status: 7,872 (89.07%) married, 966 (10.93%) unmarried/divorced/widowed.

No statistically significant differences were found between groups in gender, age, or marital status ( $^2$*{gender}=0.183, P=0.669;* $^2${age}=0.894, P=0.925; $^2$_{marital}=0.049, P=0.825) .

### Comparison of Blood Pressure Control

**Blood pressure control rates:** No significant difference existed between groups in 2021 (P>0.05) or 2023 (P>0.05). However, the contracted group' s 2023 control rate significantly improved compared to its 2021 baseline (P<0.05), while the non-contracted group' s improvement was not significant (P>0.05) .

**Blood pressure measurements:** Both groups showed significant reductions in left diastolic, left systolic, right diastolic, and right systolic blood pressure from 2021 to 2023 (P<0.05). The contracted group demonstrated significantly greater reductions in left diastolic and right systolic blood pressure compared to the non-contracted group (P<0.05), though differences in left systolic and right diastolic reductions were not significant (P>0.05) .

### Comparison of Physical Examination Results

In 2021, no significant differences existed between groups in BMI distribution, central obesity, elevated fasting glucose, dyslipidemia, liver dysfunction, kidney dysfunction, blood routine abnormalities, urine routine abnormalities, electrocardiogram abnormalities, or ultrasound abnormalities (P>0.05).

In 2023, significant between-group differences were observed in central obesity and electrocardiogram abnormalities (P<0.05), but not in other indicators (P>0.05). Within the contracted group, significant improvements were found in BMI distribution, central obesity, elevated fasting glucose, and electrocardiogram abnormalities between 2021 and 2023 (P<0.05), with no significant

changes in other indicators (P>0.05). In the non-contracted group, only elevated fasting glucose showed significant improvement (P<0.05), with no significant changes in other indicators (P>0.05) .

### Comparison of Lifestyle and Medication Adherence

No significant differences existed between groups in smoking, alcohol consumption, exercise, or medication adherence in either 2021 or 2023 (P>0.05). Within the contracted group, exercise patterns and medication adherence significantly improved from 2021 to 2023 (P<0.05), while smoking and alcohol consumption did not change significantly (P>0.05). The non-contracted group showed no significant changes in any lifestyle or adherence measures (P>0.05) .

### Multivariate Logistic Regression Analysis

Using blood pressure control as the dependent variable (0=not achieved, 1=achieved) and family doctor contracting as the independent variable, with 17 control variables including gender and age, multivariate logistic regression showed that contracted patients had 1.625 times higher odds of blood pressure control than non-contracted patients (95%CI=1.536-1.719) .

## Discussion

### Positive Effect on Blood Pressure Control

This study demonstrates that the "Three-Teacher Joint Management" family doctor contracted service effectively improved blood pressure control among elderly hypertensive patients in Xiamen. The 2023 control rate of 76.78% in the contracted group exceeded both the 2021 baseline (60.10%) and the non-contracted group' s rate (68.61%). Contracted patients also showed significantly greater reductions in left diastolic and right systolic blood pressure. Logistic regression confirmed that contracted patients had 1.625 times higher odds of achieving blood pressure control.

Xiamen' s model leverages specialists from tertiary hospitals to provide technical support and guidance, compensating for limitations in general practitioners' treatment capabilities and enhancing patient trust and medication adherence. Through the Xiamen Health Medical Big Data Platform, family doctors can access patients' complete medical records across all city healthcare institutions, enabling more comprehensive disease profiling, improving diagnostic and polypharmacy accuracy, and facilitating targeted personalized health interventions that shift care upstream.

### Lifestyle Improvement

Contracted patients showed significant improvements in BMI, central obesity, elevated fasting glucose, and electrocardiogram abnormalities, along with better exercise patterns and medication adherence. In contrast, non-contracted pa-

tients only showed improvements in central obesity and fasting glucose. Lifestyle intervention is fundamental to hypertension management and requires comprehensive approaches [9]. Elevated BMI increases hypertension risk, and clinical guidelines recommend maintaining BMI within 18.5–23.9 kg/m$^2$ [10]. Hyperglycemia is also a hypertension risk factor [11]. Regular exercise controls weight, improves physical fitness, reduces sympathetic nerve activity, and dilates blood vessels to assist blood pressure reduction [12].

Xiamen' s "Xiamen iHealth" mobile APP facilitates doctor-patient interaction, offering health consultation, appointment booking, chronic disease follow-up, health management, real-time vital sign monitoring through smart devices, online prescription renewal, early disease prevention, health club activities, health banking points, and targeted health education. This platform enables effective communication between family doctors and specialists, allowing real-time health management, timely intervention on risk factors, and continuous medication monitoring, ultimately promoting healthy lifestyle adoption and improving hypertension management and control rates.

**Areas for Improvement**

Xiamen' s 2023 blood pressure control rate (76.78%) among contracted elderly hypertensive patients was higher than rates reported in Shanghai' s Changzheng Town (59.01%), Shenzhen' s Nanshan District (69.64%), and Shanghai' s Putuo District (73.53%), but lower than Beijing' s Tiantan Community (79.12%) and Cangzhou City in Hebei (87.7%) [13-17]. In 2022, six national ministries issued guidance on high-quality family doctor contracted services, prompting nationwide implementation and innovation. Many successful experiences and models warrant Xiamen' s attention and learning.

Xiamen' s "Three-Teacher Joint Management" model responds to national requirements by strengthening service continuity, coordination, and comprehensiveness. However, primary care family doctor teams remain relatively weak, with insufficient numbers of general practitioners representing the main bottleneck. Three challenges persist: (1) Rising health demands due to improved living standards, accelerated population aging, and increasing chronic disease prevalence; (2) Growing workload at primary care levels as healthcare reform progresses, with most medical staff holding multiple roles; (3) Limited public awareness and recognition of family doctors and contracted services, requiring improved contracting rates.

Therefore, enhanced policy support is needed to expand service supply, improve primary care professionals' technical capabilities, and meet residents' reasonable healthcare needs. Service delivery models should be optimized to enrich content, improve quality, and encourage social forces to participate in meeting personalized and diversified health needs. Finally, publicity efforts must be strengthened to raise awareness, identify exemplary cases, and create a favorable social environment for family doctor contracted services.

## Conclusion

Xiamen' s "Three-Teacher Joint Management" family doctor contracted service model has played a positive role in community hypertension management. Under family doctor team interventions, patients receive more refined and individualized comprehensive health management, demonstrating higher compliance and better hypertension control rates. Future efforts should continue strengthening policy support, optimizing service delivery, improving quality, and fully leveraging the role of family doctor contracted services in providing integrated, continuous, and coordinated primary healthcare to genuinely enhance public satisfaction and well-being.

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## Author Contributions

CHEN Youlan and GUO Zhinan were responsible for conceptualization and design. CHEN Youlan and LAN Yanqi conducted feasibility analysis. WU Ahua, ZHANG Haixia, and HUANG Jiankang performed literature search, data collection, and organization. CHEN Youlan drafted the manuscript, analyzed and

interpreted results, and took overall responsibility. GUO Zhinan was responsible for quality control, revision, and supervision.

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*Note: Figure translations are in progress. See original paper for figures.*