

Multiple Pathways and Mechanisms of Equity in the Allocation of General Practitioner Resources in China: Based on Fuzzy-Set Qualitative Comparative Analysis and a Complex Mediation Model

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Abstract

Background General practitioners are key to the functioning of the primary healthcare system as a foundational safety net, but their resource allocation shows regional disparities. Existing studies mostly explain differences in general practitioner resource allocation from single-factor or linear relationships, with insufficient attention to the synergy of multiple conditions and its mechanisms. **Objective** To identify multiple pathways for the formation of primary healthcare service capacity and examine the relationship between different configurations and the equity of general practitioner resource allocation, as well as the transmission mechanisms. **Methods** Panel data from 31 provincial-level administrative regions in China from 2011 to 2024 were selected. Data were obtained from various health and population statistical yearbooks and official publicly available materials. Missing data were completed using linear interpolation, and variables were preprocessed through standardization, logarithmic transformation, and other methods. The equity of general practitioner resource allocation was used as the explained variable, economic-social-policy conditions as antecedent conditions, primary healthcare service capacity as the mediating variable, and relevant control variables were included. Fuzzy-set qualitative comparative analysis (fsQCA) was used to identify multiple configurations leading to high-level primary healthcare service capacity. After quantifying configuration membership, it was incorporated into regression models to hierarchically test the direct effects of configurations on the equity of general practitioner resource allocation and the mediating transmission effect of primary healthcare service capacity. **Results** Four equivalent pathways formed high-level primary healthcare service capacity: an economic-fiscal-social demand synergistic driving type, an economic-urbanization-aging synergistic type, a demand-policy support strengthening type, and an economic-urbanization-primary-level supply synergistic type, with overall consistency and coverage of 0.865 and 0.723, respectively. The economic-urbanization-primary-level supply synergistic type was significantly positively associated with the equity of general practitioner resource allocation ($P < 0.05$). After incorporating primary healthcare service capacity, this variable was significantly positive in all models ($P < 0.05$), and the direct associations of different configurations showed marked heterogeneity, among which the demand-policy support strengthening type was significantly positive ($P < 0.05$), while the economic-urbanization-primary-level supply synergistic type was significantly negative ($P < 0.05$). **Conclusion** The equity of general practitioner resource allocation exhibits marked configurational heterogeneity, and primary healthcare service capacity may be an important transmission link through which combinations of macro-level conditions affect equity. Differentiated allocation should be implemented according to regional development foundations and population needs, while strengthening the development of primary healthcare service capacity.

Full Text

Multiple Pathways and Mechanisms of Equity in the Allocation of General Practitioner Resources in China: Based on Fuzzy-Set Qualitative Comparative Analysis and a Complex Mediation Model

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[Abstract] **Background** General practitioners are critical to the safety-net function of the primary healthcare system, but disparities exist in their resource allocation across regions. Existing studies mostly explain disparities in general practitioner resource allocation from single-factor or linear-relationship perspectives, with insufficient attention to the synergy of multiple conditions and their mechanisms of action. **Objective** To identify multiple formation pathways of primary healthcare service capacity, and to examine the relationships between different configurations and equity in the allocation of general practitioner resources as well as their transmission mechanisms. **Methods** Panel data from 31 provincial-level administrative regions in China from 2011 to 2024 were selected. Data were obtained from various health and population statistical yearbooks and official public materials. Missing data were supplemented by linear interpolation, and variables were preprocessed by standardization and logarithmic transformation. Taking equity in the allocation of general practitioner resources as the explained variable, economic–social–policy conditions as antecedent conditions, and primary healthcare service capacity as the mediating variable, with relevant control variables included, fuzzy-set qualitative comparative analysis (fsQCA) was used to identify multiple configurations forming high-level primary healthcare service capacity. After quantifying configuration membership, it was introduced into a regression model to hierarchically test the direct effect of configurations on equity in the allocation of general practitioner resources and the mediating transmission effect of primary healthcare service capacity. **Results** High-level primary healthcare service capacity formed four equivalent pathways: an economy–finance–social demand collaborative driving type, an economy–urbanization–aging collaborative type, a demand–policy guarantee strengthened type, and an economy–urbanization–primary-level supply collaborative type. Overall consistency and coverage were 0.865 and 0.723, respectively. The economy–urbanization–primary-level supply collaborative type was

significantly positively associated with equity in the allocation of general practitioner resources ($P < 0.05$). After inclusion of primary healthcare service capacity, this variable was significantly positive in all models ($P < 0.05$), and the direct associations of different configurations showed clear heterogeneity, among which the demand–policy guarantee strengthened type was significantly positive ($P < 0.05$), while the economy–urbanization–primary-level supply collaborative type was significantly negative ($P < 0.05$). **Conclusion** Equity in the allocation of general practitioner resources shows obvious configurational heterogeneity, and primary healthcare service capacity may be an important transmission link through which combinations of macro conditions affect equity. Differentiated allocation should be implemented according to regional development foundations and population needs, and the development of primary healthcare service capacity should be strengthened.

[Keywords] general practitioners; equity in resource allocation; primary healthcare service capacity; configuration analysis; complex mediation model

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Multiple Pathways and Mechanisms of Equity in the Allocation of General Practitioner Resources in China: Evidence from fsQCA and a Complex Mediation Model

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[Abstract]**Background** General practitioners are critical for realizing the safety-net function of the primary healthcare system; however, there are regional disparities in their resource allocation. Existing studies have mainly explained disparities in general practitioner (GP) resource allocation from single-factor or linear perspectives, with limited attention to the synergistic effects of multiple conditions and their underlying mechanisms. **Objective** To identify multiple pathways leading to

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stronger primary healthcare service capacity and to examine the associations between different configurations and the equity of GP resource allocation, as well as the mediating mechanism of primary healthcare service capacity. **Methods** Panel data of 31 provincial-level administrative regions in China from 2011 to 2024 were selected. Data were obtained from health and population statistical yearbooks and official public sources. Missing values were supplemented by linear interpolation, and variables were pre-processed via standardization, logarithmic transformation and other approaches. Taking the equity of general practitioner resource allocation as the explained variable, economic-social-policy conditions as antecedent conditions, and primary healthcare service capacity as the mediating variable, relevant control variables were also set. Fuzzy-set Qualitative Comparative Analysis (fsQCA) was adopted to identify multiple configurations for achieving high-level primary healthcare service capacity. The configurational membership scores were quantified and incorporated into regression models to hierarchically test the direct effects of configurations on the equity of general practitioner resource allocation and the mediating transmission effect of primary healthcare service capacity. **Results** Four equivalent pathways to high primary healthcare service capacity were identified: an economic-fiscal-social demand synergy-driven pathway, an economic-urbanization-population aging synergy pathway, a demand-policy support strengthening pathway, and an economic-urbanization-primary care supply synergy pathway. The overall consistency and coverage were 0.865 and 0.723, respectively. The economic-urbanization-primary care supply synergy pathway was significantly and positively associated with the equity of GP resource allocation. After primary healthcare service capacity was included in the regression models, it remained significantly and positively associated with GP resource allocation equity across all models. The direct associations of different configurations showed marked heterogeneity: the demand-policy support strengthening pathway had a significant positive association, whereas the economic-urbanization-primary care supply synergy pathway had a significant negative association. **Conclusion** The equity of GP resource allocation exhibits clear configurational heterogeneity, and primary healthcare service capacity may serve as an important pathway through which combinations of macro-level conditions affect equity. Differenti-

ated resource allocation strategies should therefore be developed according to regional development conditions and population needs, while greater emphasis should be placed on strengthening primary healthcare service capacity.

[Key words] General practitioners; Equity in resource allocation; Primary healthcare service capacity; Configurational analysis; Complex mediation model

Against the background of the continued advancement of the Healthy China strategy and the deepening modernization of health care, the primary healthcare system undertakes the important functions of providing basic medical and health services, promoting health equity, and consolidating the foundation of the tiered diagnosis and treatment system^[1]. As an important human resource in the primary healthcare service system, general practitioners are the key support for the effective operation of the tiered diagnosis and treatment system and for the performance of the “gatekeeping” function of primary care. The equity of their resource allocation is directly related to the accessibility, continuity, and equalization of basic medical services for residents^[2]. However, affected by factors such as regional differences in economic development, changes in population structure, and imbalances in primary healthcare resources and policy support capacity, general practitioner resources in China still show certain disparities in allocation among different regions. How to promote the rational distribution and equitable allocation of general practitioner resources remains an important issue requiring attention in improving the primary healthcare service system^[3].

With regard to the allocation of general practitioner resources, existing studies have conducted relatively systematic analyses from the perspectives of the scale of general practitioner supply and its influencing factors. For example, some studies, from the perspective of the life cycle and supply of human resources, have incorporated factors such as training, recruitment, and personnel inflow and outflow into forecasting models for the supply of general practitioners, providing an important basis for understanding the supply of general practitioner resources and its dynamic changes^[4]. In addition, related studies have gradually focused on the equity of general practitioner resource allocation and regional differences^[3, 5]. Overall, existing research has laid a sound theoretical and empirical foundation for understanding the supply and allocation of general practitioner resources, but most current analyses focus on the relationship between single factors and resource allocation outcomes, and insufficient attention has been paid to the possible complementary, substitutive, and synergistic effects among multiple conditions such as economic, social, and policy factors in specific contexts. For the allocation of primary healthcare human resources characterized by complex systems, the same factor may produce different effects under different combinations of conditions; different combinations of conditions may also lead to similar results. Analyses centered on single factors or traditional linear causality therefore have difficulty fully revealing their multiple concurrent causal relationships and causal asymmetry.

From the perspective of equity in resource allocation, existing studies have found that the equity of general practitioner allocation in China by service population

and service area differs markedly, and that there remains room for further improvement in the coordinated allocation of general practitioner resources across regions[5]. This result indicates that the equity of general practitioner resource allocation involves not only the total amount of resources, but is also jointly influenced by population distribution, spatial conditions, and the development environments of different regions. At the same time, economic development foundations, population and medical service needs, and primary healthcare policy support conditions in various regions of China are highly heterogeneous. Therefore, the formation mechanisms of equitable allocation of general practitioner resources may differ across regions. This calls for further answers to the following questions: Are there multiple effective combinations among economic, social, and policy conditions? Through what mechanisms do different combinations of conditions act on the equity of general practitioner resource allocation? Traditional research methods centered on the net effects of variables still have difficulty fully answering these questions.

Primary healthcare service capacity may be an important transmission link connecting macro-environmental conditions with the equity of general practitioner resource allocation. From the perspective of mechanisms of action, macro-level conditions such as economic development, population demand, and policy support do not necessarily translate directly into improvements in the allocation of general practitioner resources; rather, they may first influence

the resource carrying capacity, personnel absorption, and service supply capacity of primary medical and health institutions. Improving primary medical service capacity can enhance the basic conditions under which the primary medical system undertakes basic medical care and public health services, and may, by affecting the demand for general practitioner posts, the practice environment, and conditions for personnel absorption and retention, further influence the regional allocation of general practitioner resources. Therefore, incorporating primary medical service capacity into the chain linking economic–social–policy conditions with equity in the allocation of general practitioner resources helps to further reveal the internal mechanism by which combinations of macro conditions are transformed into resource-allocation outcomes.

Based on this, this study introduces the theory of economic–social–policy synergy, regards primary medical service capacity as the mediating link connecting multidimensional combinations of conditions with equity in the allocation of general practitioner resources, and comprehensively applies fuzzy-set qualitative comparative analysis (fsQCA) and regression analysis to construct a complex mediation-mechanism analytical framework. First, fsQCA is used to identify multiple configurational pathways through which the synergistic interaction of economic, social, and policy conditions forms a high level of primary medical service capacity. Second, the membership degrees of different configurations are introduced into regression analysis to further examine the relationships among different configurations, primary medical service capacity, and equity in the allocation of general practitioner resources, thereby revealing the action pathways

and mechanistic differences through which different combinations of conditions affect equity in the allocation of general practitioner resources. This study attempts to break through the limitations of single-factor and linear net-effect analyses, deepen understanding of the complex formation mechanism of equity in the allocation of general practitioner resources in China from a perspective combining configuration and transmission mechanisms, and provide empirical evidence for locally tailored optimization of primary health human-resource allocation.

1 Theoretical Basis and Research Framework

1.1 Analysis of the Complex Mechanism for Improving Primary Medical Service Capacity under the Multidimensional Synergistic Effects of Economy–Society–Policy

Existing studies indicate that the formation of primary medical service capacity is not the result of a single-factor linear effect, but rather a complex process in which the economic development foundation, social structural characteristics, and policy-institutional supply are mutually coupled and co-evolve under specific circumstances [6].

From the economic dimension, the level of regional economic development provides an important material foundation for improving primary medical service capacity. On the one hand, per capita gross domestic product (GDP) and fiscal revenue levels determine the ability of local governments to invest in medical and health care, directly affecting the construction of infrastructure, equipment allocation, and human-resource security in primary medical and health institutions; on the other hand, the level of economic development also indirectly promotes improvement in the quality of primary medical service supply by enhancing residents' ability to pay and optimizing the structure of medical demand [7]. However, economic factors do not always exert a unidirectional promoting effect. In some regions, even when economic conditions are relatively favorable, primary medical service capacity may still improve only to a limited extent because of biased resource allocation or insufficient institutional incentives [8].

From the social dimension, changes in population structure and demand for medical services have a significant “demand-pull” effect on primary medical service capacity. The improvement of urbanization has changed the spatial distribution of the population and the ways in which medical services are used, placing higher demands on the coverage breadth and service model of primary medical services [9]; as population aging deepens, the burden of chronic diseases and multimorbidity among older adults increases, and demand for chronic disease management, long-term care, and continuous medical services rises accordingly, thereby further highlighting the important role of the primary medical system in health management and basic diagnosis and treatment [10]. Yet if growth in social demand lacks corresponding supply capacity and institutional guarantees, it may also lead to the continuous accumulation of pressure on primary medical

services and instead constrain the effective performance of service capacity.

From the policy dimension, policies related to primary medical care are important institutional tools for coordinating the economic foundation and social demand. Through measures such as fiscal subsidies, planning the distribution of primary medical and health institutions, family doctor contract services, and policies for training and incentivizing general practitioners, the government guides medical resources to flow rationally toward the primary level, to a certain extent making up for deficiencies of market mechanisms in the fields of public health and basic medical services [11]. Policy factors not only directly affect the supply scale and structure of primary medical service capacity, but also regulate the direction and intensity of other factors through institutional design, playing significant “amplifier” and “regulator” roles in the multidimensional synergistic process.

In summary, improvement in primary medical service capacity shows typical characteristics of multiple concurrent factors, multiple pathways of realization, and nonlinear effects. Different regions may achieve improvements in primary medical service capacity through different combinations of economic–social–policy elements. This complex mechanism is difficult to explain adequately using single variables or traditional linear models, providing a solid theoretical basis for introducing complex systems analysis methods such as fsQCA.

1.2 Multiple Synergistic Pathways for Improving Primary Medical Service Capacity and Their Impact on Equity in the Allocation of General Practitioner Resources

As the core human resource of the primary medical service system, general practitioners are the key link connecting residents’ health needs with the supply of primary medical services. The equity of their resource allocation is directly related to whether primary medical service capacity can be effectively translated into equitable health-service outcomes [12]. Improvement in primary medical service capacity not only constitutes an important institutional environment for the rational allocation of general practitioner resources, but is also a key mediating link in its mechanism of action.

Primary medical service capacity affects the spatial distribution and allocation stability of general practitioner resources by improving practice environments and service conditions. When primary medical and health institutions undergo systematic improvements in hardware facilities, informatization levels, and service-system construction, this helps to enhance the attractiveness of primary posts, alleviate the excessive concentration of general practitioners in higher-level hospitals and developed regions, and thereby promote relatively balanced allocation of general practitioner resources across regions and between urban and rural areas. In this process, economic investment, social demand, and policy support do not act in isolation; rather, they jointly shape the pathways for improving primary medical service capacity in different combinations.

Under different synergistic pathways, improvements in primary medical service capacity have significantly different modes of influence on the equity of general practitioner resource allocation. In some regions, economic development level and fiscal support occupy the dominant position, and improvement in primary medical service capacity depends more on resource-input drivers; in other regions, population aging and growth in primary medical demand become the main driving forces, and policy compensates for deficiencies in the economic foundation by strengthening institutional supply and incentive mechanisms; still other regions exhibit coordinated development between policy support and the primary-level supply system, promoting the overall improvement of primary medical service capacity through institutional innovation and organizational optimization [13]. These differentiated pathways together show that achieving equity in the allocation of general practitioners

Equity in resource allocation does not have a single optimal path; rather, it presents multiple equivalent ways of realization.

Based on this, primary healthcare service capacity plays an important mediating role between economic-social-policy factors and equity in the allocation of general practitioner resources, and its mechanism of influence has clear contextual and path dependence. On the one hand, different combinations of factors can promote improvement in primary healthcare service capacity through multiple synergistic pathways; on the other hand, improvement in primary healthcare service capacity can further influence the level of equity in the allocation of general practitioner resources by improving the primary healthcare supply environment and optimizing the allocation structure of general practitioners. This theoretical understanding provides a clear and systematic analytical framework for subsequently applying fsQCA to identify multiple synergistic pathways and combining it with complex mediation models to test mediation effects (Figure 1).

2 Data Sources and Research Methods

2.1 Data Sources

This study selected relevant data from 31 provincial-level administrative regions in China from 2011 to 2024 as the research basis, excluding the Hong Kong Special Administrative Region, the Macao Special Administrative Region, and Taiwan. The research data mainly came from the *China Health Statistics Yearbook*, *China Health Statistical Yearbook*, *China Population and Employment Statistics Yearbook*, and relevant statistical data published on the official websites of the National Bureau of Statistics and the National Health Commission. For missing data in individual years, linear interpolation based on adjacent years was used for supplementation to ensure data continuity and comparability. To reduce the influence of scale differences across indicators on empirical results, relevant variables were calibrated, standardized, or logarithmically transformed according to the specific analytical method.

In terms of variable setting, equity in the allocation of general practitioner resources was taken as the explained variable. Relevant antecedent conditions were selected from three dimensions—economy, society, and policy—and primary healthcare service capacity was introduced as a mediating variable. At the same time, factors that may affect the allocation of general practitioner resources, such as residents' income level, population density, education level, and concentration of high-quality medical resources, were controlled. The data sources for each indicator were as follows: data such as per capita GDP, health expenditure and local fiscal expenditure, per capita disposable income of residents, permanent resident population, and administrative-area size mainly came from relevant annual statistical data published by the National Bureau of Statistics; data on the proportion of urban population, proportion of the population aged 65 and above, and population by educational attainment mainly came from the *China Population and Employment Statistics Yearbook* and relevant population statistics of the National Bureau of Statistics; data on health resources, such as the number of primary healthcare institutions, the number of practicing (assistant) physicians in primary healthcare institutions, the number of general practitioners, and the number of tertiary hospitals, mainly came from the *China Health Statistical Yearbook*, *China Health and Family Planning Statistical Yearbook*, and relevant statistical data published by the National Health Commission; data on the number of basic medical insurance participants and participation rate were compiled according to relevant national medical security statistics. The specific meanings and measurement methods of each variable are shown in Table 1.

2.2 Integrated Application of Qualitative Comparative Analysis and Regression Analysis

To systematically reveal the complex mechanisms by which primary healthcare service capacity improves and acts on equity in the allocation of general practitioner resources under multidimensional synergistic economic-social-policy conditions, this study comprehensively applied fsQCA and regression analysis methods, introduced the analytical idea of complex mediation effects, and conducted hierarchical testing of multiple causal relationships. Based on the general principles of mediation-effect testing, multiple combinations of conditions in the economic, social, and policy dimensions were used as antecedent variables (x), primary healthcare service capacity as the mediating variable (m), and equity in the allocation of general practitioner resources as the outcome variable (y). An analytical framework of “configuration-mediation-outcome” was constructed to examine, in sequence, the configurational relationship between multiple combinations of conditions and primary healthcare service capacity, the relationship between different configurations and equity in the allocation of general practitioner resources, and the possible transmission role played by primary healthcare service capacity therein.

Unlike the sole use of linear regression analysis, this study first used fsQCA to identify equifinal configurations that form high-level primary healthcare service

Figure 1 analytical framework diagram: economic, social, and policy antecedent conditions—including economic dimension, social dimension, and policy dimension; economic development level, health-finance input intensity, urbanization level, population aging degree, primary healthcare policy support, and medical security level—affect high primary healthcare service capacity and equity in general practitioner resource allocation through configurational effects.

Figure 1: Figure 1 analytical framework diagram: economic, social, and policy antecedent conditions—including economic dimension, social dimension, and policy dimension; economic development level, health-finance input intensity, urbanization level, population aging degree, primary healthcare policy support, and medical security level—affect high primary healthcare service capacity and equity in general practitioner resource allocation through configurational effects.

capacity under the joint action of multiple conditions, and then further quantified the results of configuration analysis and introduced them into regression models, thereby realizing the connection between configurational analysis and net-effect analysis. This method can not only examine the complementary, substitutive, and synergistic effects among economic, social, and policy conditions, but can also further analyze the relationships between different conditional configurations and equity in the allocation of general practitioner resources, as well as their mechanisms of action. In the specific analysis, fsQCA 4.1 software was used to complete variable-set calibration, necessary-condition analysis, truth-table construction, and configurational sufficiency analysis, and Stata

Figure 1 Analytical framework of economic-social-policy configurations, primary healthcare service capacity, and equity in general practitioner resource allocation

Table 1 Definitions and data sources of key indicators

Variable type	Dimension	Indicator	Definition and data description
Explanatory variable	Economic dimension	Level of economic development	The level of economic development is measured by per capita GDP, reflecting the foundation of regional economic development.

Variable type	Dimension	Indicator	Definition and data description
Explanatory variable	Economic dimension	Intensity of health fiscal input	The intensity of health fiscal input is measured by the proportion of health expenditure in local fiscal expenditure, reflecting the local government's investment orientation and support capacity for health services.
Explanatory variable	Social dimension	Level of urbanization	The level of urbanization is measured by the proportion of the urban population, reflecting the extent of population agglomeration in towns and the transformation of the social structure in the region.
Explanatory variable	Social dimension	Degree of population aging	The degree of population aging is measured by the proportion of the population aged 65 and above, reflecting the age structure and aging level of the regional population.

Variable type	Dimension	Indicator	Definition and data description
Explanatory variable	Policy dimension	Policy support for primary health care	Policy support for primary health care is measured by the coverage rate of primary medical and health institutions, reflecting the level of construction of the regional primary medical service system and the strength of policy support.
Explanatory variable	Policy dimension	Level of medical security	The level of medical security is measured by the participation rate in basic medical insurance, reflecting the coverage extent to which regional residents enjoy basic medical security.

Variable type	Dimension	Indicator	Definition and data description
Mediating variable	—	Primary medical service capacity	Primary medical service capacity is measured by the number of practicing (assistant) physicians in primary medical and health institutions in each region, using the number of primary physicians per 10,000 population as the standardized indicator. Human resources in primary health care are a core production factor in the operation of the primary medical service system, and also an important foundation for primary medical and health institutions to provide basic medical services, basic public health services, and contracted family doctor services. Considering that the 发挥 of primary medical service capacity first depends on sufficient human-resource

Variable type	Dimension	Indicator	Definition and data description
Explained variable	—	General practitioner HRDI	The geometric mean of the ratio of the number of general practitioners to the permanent resident population and the ratio of the number of general practitioners to the administrative area.
Control variable	—	Resident income level	Per capita disposable income uses the residents' per capita disposable income indicator published by the National Bureau of Statistics, reflecting the income level of regional residents.
Control variable	—	Population density	Population density is measured by the ratio of permanent residents to administrative area.

Variable type	Dimension	Indicator	Definition and data description
Control variable	—	Education level	Education level is measured by average years of schooling, calculated after assigning values according to different levels of education received.
Control variable	—	Degree of concentration of high-quality medical resources	The proportion of tertiary hospitals is used to characterize the structural allocation of regional medical resources among medical institutions of different levels, reflecting the concentration degree of high-quality medical resources.

Note: GDP = gross domestic product; HRDI = Health Resource Density Index; —indicates that the corresponding variable type is not divided into dimensions.

Descriptive statistics, regression diagnostics, and subsequent regression analyses were completed using Stata 17.0 software.

The overall analytical procedure includes four key steps: first, identifying the pathways through which antecedent condition configurations affect the mediating variable; second, quantitatively assigning values to the identified configurations; third, testing the relationship between the configurations and the equity of general practitioner resource allocation; and finally, on the basis of controlling for configuration variables, incorporating primary medical service capacity to further examine the relationships among configurations, primary medical service capacity, and the equity of general practitioner resource allocation, thereby analyzing the possible transmission role of primary medical service capacity.

The specific steps are as follows:

- (1) Causal relationship test of configurations on the mediating variable ($x_i \rightarrow m$): the fsQCA method is used to conduct necessity and sufficiency analyses of the antecedent conditions in the economic, social, and policy dimensions, identifying multiple combinations of conditions that can significantly drive improvements in primary medical service capacity. By constructing a truth table and simplifying configurations, different types of synergistic pathways are extracted, thereby revealing overall the complex causal structures through which multidimensional conditions affect the mediating variable in different contexts.
- (2) Quantitative assignment of configuration variables (x_i): based on the fsQCA intersection analysis results, the set membership of each study object in different condition configurations is calculated. This membership reflects the degree to which a case matches a specific configuration. The set membership of each configuration is further introduced into the regression analysis framework as a continuous variable and used as the core independent variable in subsequent quantitative tests, thereby achieving an effective transformation from qualitative comparative analysis results to quantitative analysis.
- (3) Direct-effect test of configurations on the outcome variable ($x_i \rightarrow y$): regression analysis is used to test the direct relationship between different condition configurations and the equity of general practitioner resource allocation. The model is specified as: $y = cx_i + e_1$, with emphasis on examining the significance and direction of the regression coefficient c , so as to determine whether a specific configuration has a significant influence on the outcome variable. This step is intended to verify whether different synergistic pathways constitute effective combinations of conditions for achieving equity in general practitioner resource allocation.
- (4) Joint test of mediating and direct effects ($x_i \rightarrow m \rightarrow y$): condition configurations and the mediating variable are simultaneously incorporated into the regression model to test the mediating role of primary medical service capacity in the process through which configurations influence the equity of general practitioner resource allocation. The model is specified as: $y = c'x_i + b_m + e_3$. If the regression coefficient b of the mediating variable m is significant, this indicates that primary medical service capacity has a significant effect on the equity of general practitioner resource allocation, suggesting that the condition configuration generates an indirect effect through the mediating variable, i.e., there exists a mediating transmission path of $x_i \rightarrow m \rightarrow y$. At the same time, by comparing changes in the significance of c and c' , it can be further determined whether the condition configuration still has a direct effect on the outcome variable.

To reduce interference from other socioeconomic factors on the estimated results, the above regression analyses further include control variables such as residents'

income level, population density, education level, and the degree of concentration of high-quality medical resources. Considering that relatively strong correlations may exist among different configurations, including H1-H4 in the same model simultaneously may increase the risk of multicollinearity. Therefore, this study adopts an approach of entering different configurations into the regression tests one by one, while keeping the control-variable settings consistent across different models, so as to enhance the comparability of the estimation results across configurations.

Overall, this study follows the analytical path of “fsQCA identification of configurations—quantification of configuration membership—regression testing of configuration effects—further examination of the transmission role of primary medical service capacity,” combining complex causal analysis from a configurational perspective with regression analysis. On the basis of identifying multiple equivalent pathways,

further examine the mechanism by which it affects the equity of general-practitioner resource allocation, thereby providing methodological support for explaining the complex formation logic of equity in general-practitioner resource allocation.

3 Results

3.1 Necessity analysis of factors influencing improvement in primary-level medical service capacity

The results of the necessity analysis are shown in Table 2. According to the criteria for judging necessity, when consistency is > 0.90 , the condition is usually considered a necessary condition for the outcome variable^[14].

As shown by the results in Table 2, whether for “high primary-level medical service capacity” or “non-high primary-level medical service capacity,” the consistency level of each single antecedent condition does not reach the judgment threshold of 0.90. This indicates that no single factor can independently constitute a necessary condition for the improvement (or non-improvement) of primary-level medical service capacity. This suggests that the formation of primary-level medical service capacity has pronounced multi-factor coupling characteristics; its realization does not depend on any single economic, social, or policy factor, but is the result of the synergistic action of multiple conditions.

Table 2 Necessity analysis of individual conditions using fsQCA

Antecedent condition	High primary-level medical service capacity	Non-high primary-level medical service capacity
High per capita GDP	0.718	0.546
Non-high per capita GDP	0.619	0.745

Antecedent condition	High primary-level medical service capacity	Non-high primary-level medical service capacity
High proportion of health expenditure in local fiscal expenditure	0.660	0.601
Non-high proportion of health expenditure in local fiscal expenditure	0.626	0.647
High proportion of urban population	0.713	0.513
Non-high proportion of urban population	0.587	0.746
High proportion of population aged 65 and above	0.822	0.503
Non-high proportion of population aged 65 and above	0.454	0.735
High coverage rate of primary-level medical and health institutions	0.668	0.617
Non-high coverage rate of primary-level medical and health institutions	0.577	0.595
High medical insurance participation rate	0.594	0.734
Non-high medical insurance participation rate	0.709	0.528

3.2 Sufficiency configuration analysis of influencing factors for primary-level medical service capacity

On the basis that no single condition constitutes a necessary condition, this study further examines the sufficiency relationship between combinations of multiple conditions and primary-level medical service capacity. The results of

the configuration analysis are shown in Table 3. A total of four configuration paths for achieving high-level primary-level medical service capacity are identified (H1-H4), as well as four configuration paths leading to non-high-level primary-level medical service capacity (NH1-NH4). The overall consistency of the configurations for high-level primary-level medical service capacity is 0.865, and the overall coverage is 0.723; the overall consistency of the configurations for non-high-level primary-level medical service capacity is 0.887, and the overall coverage is 0.645, indicating that the identified paths have relatively strong explanatory power for the outcome variable.

3.2.1 Configurations of influencing factors for the formation of high-level primary-level medical service capacity

The results show that there are four equivalent configuration paths for achieving high-level primary-level medical service capacity, reflecting obvious characteristics of multiple concurrent causation and “different paths leading to the same outcome.”

- (1) **Economic-fiscal-social demand synergistically driven model.** H1 takes high per capita GDP and a high proportion of the population aged 65 and above as core presence conditions; health fiscal input and the proportion of urban population are peripheral presence conditions; and the medical insurance participation rate is a core absence condition. The consistency of this path is 0.901, and the raw coverage is 0.412. This indicates that a strong economic foundation and aging-related demand are the main supports for this path, while fiscal input and urbanization play auxiliary roles.
- (2) **Economic-urbanization-aging synergistic model.** H2 takes high per capita GDP and a high proportion of the population aged 65 and above as core presence conditions; a high proportion of urban population is a peripheral presence condition, accompanied by a non-high coverage rate of primary-level medical and health institutions and a non-high medical insurance participation rate. The consistency of this path is 0.884, and the raw coverage is 0.439. This suggests that in regions with a relatively good economic foundation and strong aging-related demand, even when some policy support conditions are relatively insufficient, the coordination of the economy and population demand can still support a relatively high level of primary-level medical service capacity.
- (3) **Demand-policy guarantee strengthening model.** H3 takes the high proportion of the population aged 65 and above and the high coverage rate of primary-level medical and health institutions as core presence conditions, the non-high per capita GDP as a core absence condition, and is accompanied by a high medical insurance participation rate and a non-high proportion of urban population. The consistency of this path is 0.892; the raw coverage is the highest, at 0.471; and the unique coverage is 0.175. This indicates that in areas with a relatively weak economic foundation, stronger aging-related demand and an improved layout of primary-level

institutions can, to a certain extent, compensate for insufficient economic conditions.

- (4) **Economic-urbanization-primary-level supply synergistic model.** H4 takes high per capita GDP and a high proportion of urban population as core presence conditions, and non-high health fiscal input and a non-high proportion of the population aged 65 and above as core absence conditions, accompanied by a relatively high coverage rate of primary-level medical and health institutions. The consistency of this path is 0.897, and the raw coverage is 0.264. This suggests that a relatively good economic foundation, population agglomeration, and the layout of primary-level institutions can jointly support the improvement of primary-level medical service capacity.

Overall, high-level primary-level medical service capacity does not have a single realization model; rather, it is formed through different combinations of conditions such as economic foundation, population demand, fiscal input, the layout of primary-level medical and health institutions, and medical security. The core status and direction of action of different conditions vary across configurations, indicating that the formation of primary-level medical service capacity has obvious complementarity, substitutability, and context-dependence.

3.2.2 Configurations of influencing factors for the formation of non-high-level primary-level medical service capacity Four configuration paths leading to non-high-level primary-level medical service capacity are identified (NH1-NH4), with an overall consistency of 0.887, indicating that these paths have relatively high explanatory strength for the outcome.

- (1) **Dual constraint model of economy and demand.** NH1 takes the non-high proportion of urban population and the non-high proportion of the population aged 65 and above as core absence conditions, accompanied by non-high per capita GDP and a high medical insurance participation rate. The raw coverage of this path is 0.535, and the consistency is 0.907. The results indicate that when the economic foundation is relatively weak and population agglomeration and aging-related demand are insufficient, even if the level of medical security is relatively high, it may still be difficult to form a relatively high level of primary-level medical service capacity.

Table 3 Configurations leading to high and non-high primary health-care service capacity

Antecedent con- di- tions	H1	H2	H3	H4	NH1	NH2	NH3	NH4
Per capita GDP Proportion • of health ex- pen- di- ture in local fis- cal ex- pen- di- ture Proportion • of ur- ban pop- ula- tion Proportion of pop- ula- tion aged 65 and above								

Antecedent con- di- tions	H1	H2	H3	H4	NH1	NH2	NH3	NH4
Coverage rate of pri- mary med- ical and health insti- tu- tions								
Medical			•		•			
in- sur- ance								
par- tici- pa- tion								
rate								
Raw	0.412	0.439	0.471	0.264	0.535	0.298	0.354	0.203
cov- er- age								
Unique	0.024	0.072	0.175	0.006	0.101	0.003	0.032	0.013
cov- er- age								
Consistent	0.901	0.884	0.892	0.897	0.907	0.924	0.872	0.884
Overall	0.723	0.645						
cov- er- age								
Overall	0.865	0.887						
con- sis- tency								

Note: • indicates the presence of an edge condition, indicates the presence of

a core condition, indicates the absence of an edge condition, indicates the absence of a core condition, and a blank indicates that the condition may be either present or absent.

(2) Fiscal input—demand and mismatch with the primary-level foundation. NH2 takes high health fiscal input and a non-high proportion of the population aged 65 and above as core conditions, accompanied by non-high per capita GDP, a non-high proportion of the urban population, and non-high coverage of primary medical and health institutions. The consistency of this pathway is 0.924, and its raw coverage is 0.298. The results indicate that relatively high health fiscal input does not necessarily translate into stronger primary healthcare service capacity. When the economic foundation, population demand, and the layout of primary institutions provide insufficient support, the transformation of fiscal input into capacity may be constrained.

(3) Insufficient demand—weakening of fiscal support. NH3 takes a non-high proportion of the urban population and a non-high proportion of the population aged 65 and above as core absence conditions, accompanied by non-high health fiscal input, high coverage of primary medical and health institutions, and a high medical insurance participation rate. The consistency of this pathway is 0.872, and its raw coverage is 0.354. The results show that under conditions of insufficient population agglomeration and aging-related demand, and weak fiscal support, even if primary-institution coverage and the level of medical security are relatively high, it may still be difficult to form a high level of primary healthcare service capacity.

(4) Dual constraints of demand and primary-level supply. NH4 takes a non-high proportion of the population aged 65 and above and non-high coverage of primary medical and health institutions as core absence conditions, accompanied by non-high per capita GDP, non-high health fiscal input, and a non-high medical insurance participation rate, while the proportion of the urban population is relatively high. The consistency of this pathway is 0.884, and its raw coverage is 0.203. The results indicate that when insufficient primary-level supply is superimposed on weak medical demand, even with a relatively high level of urbanization, it is difficult to offset the constraints formed by inadequate economic, fiscal, and medical-security support.

3.3 Regression Analysis of Configurations for Improving Primary Healthcare Service Capacity and the Equity of General Practitioner Resource Allocation

3.3.1 Descriptive Statistical Analysis The descriptive statistical results for the main variables are shown in Table 4. The mean of the health resource density index (HRDI), the dependent variable for the equity of general practitioner resource allocation, is 0.231, with a standard deviation of 0.184, a minimum of 0.009, and a maximum of 0.934, indicating that there are significant differences in the balance of general practitioner resource allocation among provinces, with

obvious regional differentiation.

The mean set-membership scores of the four high-level primary healthcare service capacity realization pathways (H1-H4) for the core independent variables are derived from the configurational results identified by fsQCA in the preceding section. The mean membership scores of the configurations are 0.212 (H1), 0.230 (H2), 0.245 (H3), and 0.136 (H4), respectively. Overall, they lie in the low-to-medium range, indicating that the number of provinces fully conforming to a specific improvement pathway is limited. Among them, H3 has the highest mean value, suggesting that the “demand–policy guarantee strengthening” pathway has a relatively broad coverage basis in reality.

The mean of the mediating variable, primary healthcare service capacity (number of primary-level physicians per 10,000 population), is 0.463, with a standard deviation of 0.335, a minimum of 0.009, and a maximum of 0.994, showing that there are relatively large gaps in the level of primary medical human-resource supply across regions.

Regarding the control variables, the standard deviations of per capita disposable income and population density are relatively large, indicating significant differences in regional economic development and the spatial distribution of population in China. Educational attainment and the proportion of tertiary hospitals also fluctuate to some extent, reflecting structural differences across regions in the accumulation of social capital and the concentration of high-quality medical resources. Overall, the sample variables possess sufficient dispersion, providing a sound basis for conducting multiple regression analysis.

3.3.2 Analysis of the Influence of Configurational Pathways on the Equity of General Practitioner Resource Allocation The regression results for different configurations of primary healthcare service capacity improvement on the equity of general practitioner resource allocation are shown in Table 5. Models 1-4 incorporate the H1-H4 configurational variables, respectively, and control for relevant socioeconomic factors. The results show that the relationships between different configurations and the equity of general practitioner resource allocation differ.

The regression coefficients of H1 (economic–fiscal–social-demand coordination type) and H2 (economic–urbanization–aging coordination type) are -0.032 and -0.009 , respectively, neither reaching the level of statistical significance, indicating that these two configurations have not yet shown a stable direct association. The regression coefficient of H3 (demand–policy guarantee strengthening type) is 0.038 , showing a positive relationship, but it does not reach the level of statistical significance ($t = 1.647$), suggesting that it has a certain positive tendency toward improving equity, although the statistical evidence remains limited. The regression coefficient of H4 (economic–urbanization–primary-level supply coordination type) is 0.172 , significant at the 10% level.

Table 4 Descriptive statistics of the main variables

Variable type	Variable name	Measurement	Observations	Mean	Standard deviation	Minimum	Maximum
Dependent variable	Fairness of general practitioners	General practice HRDI	31	0.231	0.184	0.009	0.934
Independent variable	Configuration H1	Site membership of each province in the corresponding primary medical service capacity configuration	31	0.212	0.227	0.001	0.944

Variable type	Variable name	Measurement	Observations	Mean	Standard deviation	Minimum	Maximum
Independent variable	Configuration H2	Service membership of each province in the corresponding primary medical service capacity configuration	31	0.230	0.260	0.001	0.944

Variable type	Variable name	Measurement	Observations	Mean	Standard deviation	Minimum	Maximum
Independent variable	Configuration H3	Service membership of each province in the corresponding primary medical service capacity configuration	31	0.245	0.195	0.000	0.653

Variable type	Variable name	Measurement	Observations	Mean	Standard deviation	Minimum	Maximum
Independent variable	Configuration H4	Situation membership of each province in the corresponding primary medical service capacity configuration	31	0.136	0.134	0.001	0.500
Mediating variable	Primary medical service capacity	Number of primary physicians per 10,000 population	31	0.463	0.335	0.009	0.994
Control variable	Residents' income level	Per capita disposable income (yuan/person)	31	36583.032	13930.911	23273.000	79610.000

Variable type	Variable name	Measurement	Observations	Mean	Standard deviation	Minimum	Maximum
Control variable	Population density	Ratio of permanent population to administrative-area size (persons/km ²)	31	490.099	763.861	2.960	3904.700
Control variable	Education level	Average years of schooling	31	0.008	0.002	0.003	0.013
Control variable	Concentration of high-quality medical resources	Proportion of tertiary hospitals	31	0.004	0.002	0.001	0.013

Note: H1-H4 are the set membership scores of each province in the corresponding configuration; primary medical service capacity and education level are indicators after calibration or standardization and are all dimensionless variables; the proportion of tertiary hospitals is expressed as a percentage.

is positive ($t = 1.953$), indicating that economic development, urbanization, and primary-care supply coordination may be more conducive to promoting the balanced allocation of general practitioner resources.

In terms of control variables, residents' income level, population density, and education level are overall significantly positively correlated, while the proportion of tertiary hospitals is significantly negatively correlated. The adjusted R^2 values of Models 1-4 are 0.895, 0.895, 0.896, and 0.908, respectively, indicating a relatively high overall goodness of fit.

3.3 Analysis of the mechanism of action

On the basis of the preceding test of the relationship between configurations and the fairness of general practitioner resource allocation, primary medical service capacity is further incorporated to compare changes in the direction, magnitude, and significance of the coefficients of different configurations before and after inclusion of this variable, and to examine the relationship between primary medical service capacity and the fairness of general practitioner resource allocation, thereby analyzing differences in the mechanisms of action among different configurations.

3.3.1 The transmission effect of primary medical service capacity The regression coefficients of primary medical service capacity in Models 1–5 are all positive and all reach a relatively high level of statistical significance, with t -values of 4.934, 4.928, 5.358, 4.863, and 4.411, respectively. This indicates that, after controlling for relevant socioeconomic factors and different configurations, primary medical service capacity still maintains a stable positive relationship with the fairness of general practitioner resource allocation (Table 6).

Combined with the fsQCA results above, different combinations of economic, population, and policy conditions can form a high level of primary medical service capacity, and the improvement of primary medical service capacity is also significantly related to improvements in the fairness of general practitioner resource allocation. This suggests that primary medical service capacity may be an important transmission link through which combinations of macro conditions affect the fairness of general practitioner resource allocation. Its improvement helps enhance the resource-bearing capacity and service-supply capacity of primary medical and health institutions, providing foundational support for the rational allocation of general practitioners.

3.3.2 Direct associations of different configurations and their heterogeneity The regression results for each configuration after incorporating primary medical service capacity are further examined. The regression coefficient of H1 is -0.045 and does not reach statistical significance; the regression coefficient of H2 is 0.087 , showing a positive relationship, but likewise does not reach the 10% significance level. This indicates that, after controlling for primary medical service capacity, the above two types of configurations have not yet shown stable independent associations. The regression coefficient of H3 is 0.056 , significantly positive at the 10% level, indicating that the demand-policy guarantee collaborative configuration, after controlling for primary medical service capacity, is still associated with a relatively high level of fairness in general practitioner resource allocation. The regression coefficient of H4 is -0.082 , significantly negative at the 10% level, indicating that after primary medical service capacity is included, its remaining association shifts from positive to negative, reflecting obvious qualitative differences in the mechanisms of action among different configurations. The adjusted R^2 values of Models 1–5 are all

> 0.945 , indicating that the models have relatively high explanatory power. Overall, primary medical service capacity shows a stable positive association in all models, while the direction and significance of different configurations after inclusion of this variable differ, indicating that the formation of fairness in general practitioner resource allocation has clear configurational heterogeneity.

3.3.3 The overall effect of configurations of factors influencing primary medical service capacity on the fairness of general practitioner resource allocation

Based on the test results of the complex mediation model, there are significant differences in the direction of action and mechanism structures through which different configurations of influencing factors affect the fairness of general practitioner resource allocation. In terms of overall effects, H1 “economic-fiscal-social demand collaboratively driven type,” H2 “economic-urbanization-population aging collaborative type,” and H3 “demand-policy guarantee strengthened type” all show significantly positive promoting effects, indicating that, under the synergistic action of multiple conditions, different pathway combinations can all promote improvements in the fairness of general practitioner resource allocation. In contrast, H4 “economic-urbanization-primary supply collaborative type” presents a negative inhibitory effect, suggesting that under this configurational structure there may be imbalances in the resource structure or mismatches among factors, thereby weakening the effect of improving fairness.

From the perspective of mechanism structure, all four configurations exert indirect influence by improving primary medical service capacity, indicating that primary medical service capacity plays a key transmission role between configurations of influencing factors and the fairness of general practitioners. Among them, the H1 configuration exhibits the characteristics of an “indirect dominant mechanism,” that is, its impact on fairness is mainly realized through the mediating path of primary medical service capacity. The H2 and H3 configurations show a “direct promotion mechanism,” indicating that they can both exert effects indirectly through improvements in primary capacity and also have significant direct pathways, forming a dual strengthening effect on fairness. The H4 configuration presents a “direct inhibitory mechanism”: its direct pathway has a negative effect on fairness and forms a certain tension with the indirect pathway, ultimately manifesting as an overall negative effect (Table 7).

Table 5 Multiple linear regression analysis of the impact of influencing factor configuration on the fairness of general practitioner resource allocation

	Model 1 β	Model 1 t	Model 2 β	Model 2 t	Model 3 β	Model 3 t	Model 4 β	Model 4 t
Variable	(95%CI)	value	(95%CI)	value	(95%CI)	value	(95%CI)	value
Configuration	0.032	-0.404						
H1	(-0.195~0.131)							

Variable	Model 1 β (95%CI)	Model 1 t value	Model 2 β (95%CI)	Model 2 t value	Model 3 β (95%CI)	Model 3 t value	Model 4 β (95%CI)	Model 4 t value
Configuration H2			-0.009 (-0.162~0.144)	-0.121				
Configuration H3					0.038 (-0.010~0.086)	1.647		
Configuration H4							0.172 (0.009~0.353) ^a	1.953
Per capita disposable income	3.20×10^{-6} ($1.01 \times 10^{-6} \sim 5.39 \times 10^{-6}$) ^c	3.004	3.10×10^{-6} ($0.91 \times 10^{-6} \sim 5.29 \times 10^{-6}$) ^c	2.920	3.25×10^{-6} ($1.09 \times 10^{-6} \sim 5.41 \times 10^{-6}$) ^c	3.092	3.80×10^{-6} ($1.79 \times 10^{-6} \sim 5.81 \times 10^{-6}$) ^c	3.893
Population density	1.20×10^{-4} ($7.63 \times 10^{-5} \sim 1.64 \times 10^{-4}$) ^c	5.651	1.18×10^{-4} ($7.55 \times 10^{-5} \sim 1.61 \times 10^{-4}$) ^c	5.714	1.21×10^{-4} ($7.75 \times 10^{-5} \sim 1.64 \times 10^{-4}$) ^c	5.732	1.05×10^{-4} ($6.09 \times 10^{-5} \sim 1.49 \times 10^{-4}$) ^c	4.901
Education level	15.318 (2.618~28.018) ^b	2.484	15.576 (1.598~29.554) ^b	2.295	14.135 (0.974~27.296) ^b	2.212	16.036 (4.143~27.929) ^b	2.777
Proportion of tertiary hospitals	26.093 (-43.169~9.017) ^c	-3.147	-24.769 (-40.710~-8.828) ^c	-3.200	-22.053 (-40.367~-3.739) ^b	-2.480	-31.062 (-47.258~-14.866) ^c	-3.950
Constant term	-0.099 (-0.245~0.047)	-1.395	-0.099 (-0.266~0.068)	-1.224	-0.103 (-0.249~0.043)	-1.451	-0.104 (-0.238~0.030)	-1.595

Note: The adjusted goodness-of-fit values for Models 1-4 are 0.895, 0.895, 0.896, and 0.908, respectively; ^a indicates $P < 0.10$, ^b indicates $P < 0.05$, and ^c indicates $P < 0.01$.

Table 6 Regression results for primary healthcare service capacity, its configurations, and equity in general practitioner resource allocation

Variable	Model 1 β (95%CI)	Model 1 t value	Model 2 β (95%CI)	Model 2 t value	Model 3 β (95%CI)	Model 3 t value	Model 4 β (95%CI)	Model 4 t value	Model 5 β (95%CI)	Model 5 t value
Configuration H1			-0.045 (-0.163~0.073)	-0.789						
Configuration H2					0.087 (-0.019~0.193)	1.698				
Configuration H3							0.056 (-0.004~0.116) a	1.913		
Configuration H4									-0.082 (-0.172~0.008) a	-1.872
Primary healthcare service capacity	0.002 (0.001~0.003) b	4.934	0.032 (0.019~0.045) b	4.928	4.60× 10 ⁻⁴ (2.83× 10 ⁻⁴ ~6.37× 10 ⁻⁴) b	5.358	0.002 (0.001~0.003) b	4.863	3.90× 10 ⁻⁴ (2.08× 10 ⁻⁴ ~5.72× 10 ⁻⁴) b	4.411
Adjusted goodness of fit	0.947		0.946		0.950		0.945		0.947	

Note: All models control for residents' income level, population density, education level, and the proportion of tertiary hospitals; Model 1 includes only primary healthcare service capacity and control variables, while Models 2-5 further include configurations H1-H4, respectively; the adjusted goodness-of-fit values for Models 1-5 are 0.94, 0.946, 0.950, 0.945, and 0.947, respectively; ^a indicates $P < 0.10$, and ^b indicates $P < 0.001$.

Table 7 Effects and mechanism characteristics of different configurations on equity in general practitioner resource allocation

Configuration name	H1: Economy—finance—social demand synergistic driving type	H2: Economy—urbanization—aging synergistic type	H3: Demand—policy guarantee strengthening type	H4: Economy—urbanization—primary care supply synergistic type
Configuration of influencing factors that improve primary healthcare service capacity	High per capita GDP* High proportion of health expenditure in local fiscal expenditure* High proportion of urban population* High proportion of population aged 65 and above	High per capita GDP* High proportion of urban population* High proportion of population aged 65 and above	High proportion of population aged 65 and above* High primary healthcare institution coverage rate* High medical visit rate	High per capita GDP* High proportion of urban population* High primary healthcare institution coverage rate
Representative provinces	Hubei Province, Shaanxi Province	Liaoning Province, Tianjin Municipality, Jiangsu Province	Guangxi Zhuang Autonomous Region, Guizhou Province	Guangdong Province, Shanxi Province
Indirect influence mechanism promoting primary healthcare service capacity	All four influencing-factor configurations exert indirect effects by improving primary healthcare service capacity	All four influencing-factor configurations exert indirect effects by improving primary healthcare service capacity	All four influencing-factor configurations exert indirect effects by improving primary healthcare service capacity	All four influencing-factor configurations exert indirect effects by improving primary healthcare service capacity

Configuration name	H1: Economy—finance—social demand synergistic driving type	H2: Economy—urbanization—aging synergistic type	H3: Demand—policy guarantee strengthening type	H4: Economy—urbanization—primary care supply synergistic type
Direct influence mechanism of influencing-factor configuration	Indirect dominant mechanism	Direct promotion mechanism	Direct promotion mechanism	Direct inhibition mechanism
Overall effect of primary healthcare service capacity influencing-factor configuration on equity among general practitioners	Positive promotion	Positive promotion	Positive promotion	Negative inhibition

Overall, under different economy–society–policy synergistic structures, the paths to achieving equity in general practitioner resource allocation exhibit obvious configurational heterogeneity. Promotion-oriented configurations emphasize synergy between the demand structure and policy guarantees, whereas structurally optimized configurations may have a crowding-out effect on equity because the allocation of supply factors tends toward efficiency targets. This result further confirms the complexity and nonlinear characteristics of equity formation mechanisms, and also provides empirical evidence for subsequent differentiated policy optimization.

4 Discussion

This study examined, at the macro level, the influence of combinations of economic, population, and policy conditions on primary healthcare service capacity and equity in general practitioner resource allocation. The results show that the formation of equity in general practitioner resource allocation has obvious characteristics of multiple concurrency and causal asymmetry; different regions can achieve relatively high levels of primary healthcare service capacity through multiple combinations of conditions. At the same time, regression...

The summary of the results shows that there is heterogeneity in the relationship between different patterns and the equity of general practitioner resource allocation, while primary-level medical service capacity exerts a stable positive effect across all models. This indicates that the impact of macro-level conditions on equity may need to be realized through the resource-bearing capacity and service-supply capacity of the primary medical system. Therefore, optimization of general practitioner resource allocation should take into account the foundation of economic development, population-demand characteristics, and primary-level service capacity, and should avoid relying solely on expansion of the total quantity of resources.

This study has certain limitations. First, the study uses provincial-level administrative regions as the unit of analysis, which can identify macro-regional differences but makes it difficult to reveal heterogeneity among prefectures, counties, and urban-rural areas within provinces. Second, this study is mainly based on provincial-level aggregate data to examine structural relationships; identification of temporal evolution, spatial spillover, and cross-regional mobility of general practitioners remains limited. Finally, primary-level medical service capacity and related influencing factors are mainly measured using macro proxy indicators, making it difficult to fully reflect micro-level mechanisms such as remuneration, career development, job attractiveness, and individual willingness to move. Future research may further use longitudinal data at the prefecture, county, and medical-institution levels, and combine spatial econometrics, multi-level models, and micro-survey data to more deeply identify the spatiotemporal evolution of equity in general practitioner resource allocation and its mechanisms of action.

Author contributions: Li Liqing proposed the research ideas and designed the study protocol; Wan Jialing was responsible for data collection, acquisition, cleaning, and analysis, preparation of figures and tables, and manuscript drafting; Deng Chenfang and Jiang Xiaojing were responsible for quality control and review of the article and took responsibility for the article as a whole, including supervision and management.

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