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Original Article

Impact of the Family Doctor Contracting System on unmet healthcare needs in Shandong Province, China

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Abstract

Unmet healthcare needs are a significant concern in China, possibly due to the underutilization of primary healthcare services. Patients disproportionately seek tertiary hospital services, reflecting the historical underinvestment in community healthcare and a weak referral system. This misallocation of medical resources burdens the capacity of tertiary hospitals and limits access to necessary healthcare. To address this, the Family Doctor Contracting System (FDCS) was introduced to enhance community health services and reduce unmet healthcare needs. This study empirically analyzes the impact of the FDCS on unmet healthcare needs using data from the 2018 National Health Service Survey in Shandong Province, which included 27 447 individuals aged ≥18 years. An entropy balancing method was employed to address self-selection bias. Logistic regression results show that individuals contracted with family doctors (FDs) are associated with a 1.6% lower probability of experiencing unmet outpatient healthcare needs compared to those who did not participate, although the FDCS had no significant impact on unmet inpatient needs. A potential mechanism is that the FDCS has improved the accessibility of outpatient services. We found that signing up with FDs reduced the likelihood of citing inaccessibility as the main reason for unmet outpatient care needs by 43.7 percentage points, while the impact on unacceptability and unavailability was relatively more minor at 0.5 percentage points. The findings highlight the effectiveness of the FDCS in enhancing the role of primary care and improving access to healthcare. Future policy initiatives should focus on promoting the benefits of the FDCS and encouraging utilization of the FD service while strengthening community-based primary care by providing adequate infrastructure, resources, and training.

Keywords: Family Doctor Contracting System; unmet healthcare needs; entropy balancing

Key messages

- Despite nearly universal health insurance coverage in China, 13.8% of individuals reported experiencing unmet outpatient needs and 3.0% of people reported unmet inpatient care needs in Shandong, China.
- Our results from the entropy balancing method indicate that patients contracted with family doctors (FDs) are associated with a 1.6% lower probability of experiencing unmet outpatient healthcare needs, mainly due to improvements in the accessibility of healthcare services.
- The association between FD sign-up and unmet inpatient care needs is insignificant.
- The FD contracting system is found to be effective in enhancing primary care, suggesting that future policies should focus on educating residents about the benefits of FDs and promoting FD service utilization.

Introduction

Unmet healthcare needs refer to the discrepancy between the essential healthcare services required for addressing a specific health issue and the actual services provided (Sanmartin et al. 2002). This gap creates systemic obstacles to achieving universal healthcare access and establishing an effective, equitable system. It also has serious adverse consequences on population health, such as worsening chronic conditions, reduced quality of life, and increased mortality (Allen and Mor 1997, Alonso et al. 1997, Ju et al. 2017, Gibson et al. 2019, WHO 2023). Recognizing the challenge, the global health community has long prioritized unmet needs reduction as a prerequisite for health equity, advocating for multipronged interventions (UHC2030 2017).

A variety of factors have been identified to be associated with unmet healthcare needs. These factors can be categorized into three main groups based on the Anderson model of health serv-

ices utilization: the availability, accessibility, and acceptability of healthcare services (Chen and Hou 2002, Sibley and Glazier 2009, Hwang 2018, Chen and Gu 2021). High medical expenditure, as one of the accessibility-related factors, is found to be a prominent reason contributing to unmet healthcare needs in many countries. For instance, in Greece, 12% of self-reported unmet healthcare needs were due to financial constraints (Baeten et al. 2018). Other accessibility-related factors encompass geographical barriers and a lack of convenient transportation facilities (Chen and Hou 2002, Choi et al. 2019). Availability-related factors include staff shortages, resource gaps, and prolonged waiting time (Chen and Hou 2002, Manolakis and Skelton 2010, Rahman et al. 2022). Lastly, acceptability-related factors involve individuals' situations, choices, or preferences, such as scheduling conflicts, language barriers, or distrust of the healthcare system (Chen and Hou 2002).

In China, the issue of unmet healthcare needs is particularly concerning. Recent studies reveal that 11.9% of middle-aged and elderly citizens experienced unmet outpatient needs, while 5.82% reported unmet inpatient care demands in 2015. A notable disparity between rural and urban residents has also been widely documented. (Zhou et al. 2021, Gao et al. 2022, Wang et al. 2024a, b). This disparity intensifies with population aging. The high prevalence of chronic diseases among the elderly drives the demand for continuous care, which existing structures struggle to deliver (Sun and Li 2023, Wang et al. 2024a, b). Systemic failures permeate all dimensions of healthcare access. Availability challenges, such as inadequate chronic care coordination mechanisms, limited resources, and workforce shortages, hinder the effective delivery of long-term healthcare services (Sun and Li 2023). Accessibility-related factors, particularly financial constraints due to underinsurance and poverty, effect patients' ability to seek care (WHO 2015, Wu and Shen 2016). Meanwhile, despite the establishment of a nationwide community health service system, >10% of households still cannot reach their nearest health care institutions within 15 min (National Health Commission 2021).

Moreover, acceptability factors such as residents' mistrust limit the utilization of community healthcare centers (CHCs) (Pan et al. 2006, Yang and Yang 2009, Wong et al. 2017). Many patients continue to seek care at large tertiary hospitals irrespective of their disease severity, believing that these facilities offer superior quality of care (Xu et al. 2010, Zhou et al. 2017). Such perception results in an overuse of higher-level facilities while primary healthcare services remain underutilized (Xu et al. 2010, Wong et al. 2017, Gu et al. 2024). This misallocation of medical resources burdens the capacity of tertiary hospitals and limits access to necessary care for those who genuinely need advanced medical treatments, thus exacerbating inefficiencies and reducing the overall effectiveness of the healthcare system.

To optimize the allocation of scarce medical resources and reduce unmet healthcare needs, China has progressively implemented health reforms in the past two decades. In 2009, the Family Doctor Contracting System (FDCS) was first introduced as part of a new series of reforms aimed at enhancing community health services (Gu et al. 2024). The goal of the FDCS is to retain most patients within the community for their treatment, establish an orderly system of tiered medical care, facilitate two-way referrals, and distinguish between urgent and chronic care (National Health Commission 2016). Since 2010, the FDCS has been piloted in several cities. For instance, it started with two districts in 2010 and was rolled out to all community health service organizations in Beijing by 2012. In 2016, the FDCS was completely implemented nationwide (Healthcare Reform Office of State Council 2016).

Since the introduction of the FDCS in China is relatively recent, there is a significant lack of empirical evidence regarding its effectiveness in addressing unmet healthcare needs. Prior research on the FDCS has primarily focused on quality of care, patient satisfaction, and general health outcomes such as quality of life (Feng et al. 2020, Li et al. 2021). To bridge this knowledge gap and provide valuable insights into the role of the FDCS in the context of the Chinese healthcare system, this study will empirically analyze its impact on unmet healthcare needs utilizing data from the 2018 National Health Service Survey in Shandong Province. This study contributes to the current body of literature by evaluating both outpatient and inpatient care needs to provide a comprehensive analysis of the effectiveness of the FDCS across different healthcare services. Additionally, it seeks to offer valuable insights for policymakers and healthcare providers in refining the FDCS to enhance healthcare accessibility and equity and ultimately improve the overall efficiency of the healthcare system in China.

Literature review

The family doctor model and its effectiveness in high-income countries

Internationally, mature family doctor (FD) systems have proven instrumental in establishing effective tiered healthcare. These systems offer comprehensive first-contact care that includes preventive care, chronic disease management, and acute treatment. They also support long-term relationships between doctors and patients. In high-income countries, FD systems have led to measurable health improvements (Kearley et al. 2001, Allen et al. 2002). The UK's National Health Service (NHS), established since 1948, is a leading example. It runs a GP-led universal primary care system for the whole population (Roland et al. 2012). Research by Gravelle et al. (2008) on the English population revealed that FDs have a positive impact on an individual's health, with a 10% rise in the availability of FDs increasing the likelihood of residents reporting good health by 6%. In Australia, where FDs are mainly funded by a public health insurance program, it has been found that the utilization of FD services is associated with reduced risks of preventable hospitalization for patients with diabetes (Ha et al. 2018), fewer emergency visits (Yang and Messom 2021), and markedly lower mortality for patients with coronary heart diseases (Einarsdóttir et al. 2011). Similar benefits are also reported in Canadian studies (Levesque et al. 2012, McDonald et al. 2024). Out-of-pocket payments for primary care are still common in Ireland, yet free access to general practice has improved older adults' mental health and promotes more equitable care (Ma et al. 2020). In the USA, FDs offer residents individualized, first-contact healthcare services. This helps with problems of limited primary care access and discontinuity of care (Phillips et al. 2020). Services are typically funded through out-of-pocket payments or are covered by private health insurance. Studies in the USA reveal that patients consulting with their regular FDs report greater trust and service satisfaction (Baker et al. 2003). These cross-national outcomes underscore FDs' capacity to improve service access and health outcomes by providing consistent and personalized care.

In addition, FDs act as gatekeepers of health systems in many developed countries. Patients must obtain a referral from an FD before seeing a specialist. By requiring FD-mediated access to secondary services, this mechanism simultaneously achieves cost containment and quality assurance through care-pathway standardization (Forrest 2003, Sripa et al. 2019).

Effectiveness of the FDCS in China

In the Chinese context, the concept of the FDCS is still relatively new. Existing research primarily examines its effects on patient trust and satisfaction, health outcomes, and quality of care. Studies suggest that the introduction of the FDCS has led to substantial changes in the doctor–patient relationship in rural regions of China. For instance, Gu et al. (2024) found that FDCS participation is positively associated with patient trust in rural regions of China. Two pieces of research conducted in Guangzhou revealed that individuals under contractual agreements with a FD reported better quality of care and patient satisfaction, as assessed by the Primary Care Assessment Tool (Li et al. 2018, Feng et al. 2020).

In terms of direct health outcomes, research has shown positive effects associated with the FDCS. Lai et al. (2021) studied the impact of the FDCS on the overall population and revealed that contracting with FDs is associated with a greater level of health-related quality of life and improved health equity. A greater emphasis is placed on studying subgroups with chronic diseases rather than the overall population. According to Li et al. (2021), participation in the FDCS is associated with enhanced health-related quality of life among individuals with chronic illnesses. Xu et al. (2022) examined diabetes patients in Zhejiang province and found that those enrolled in the FDCS had better disease management and reduced risks of complications. Additionally, Huang et al. (2019) revealed that contracted individuals with hypertension or diabetes were more inclined to monitor their blood pressure or blood glucose on a daily or weekly basis compared to those not under contract. Among contracted patients, 85.6% had stable blood pressure control, significantly higher than the 77.7% rate observed in non-contracted patients.

Meanwhile, a number of studies have explored the effects of the FDCS on an individual's health-seeking behavior. The findings that the FDCS promotes the utilization of primary care facilities in urban China are generally consistent (Zheng et al. 2021, Zhou et al. 2021, Zhang et al. 2024). Notably, even an awareness of the FDCS is found to increase the likelihood of using CHCs as the first choice for healthcare (Zheng et al. 2021). Residents aware of the FDCS were 18.8% more likely to first utilize CHCs when they require care than those unaware of the system, while contracted residents were 22.1% more likely to opt for CHCs as their first contact than those uncontracted (Zheng et al. 2021). However, the effects of the FDCS on primary care utilization in rural setting are less conclusive (Zhou et al. 2021, Fu et al. 2024)

Despite growing interest in the FDCS, few studies have directly examined its impact on unmet healthcare needs in China. Addressing this research gap is crucial, especially considering the significant challenges of unmet healthcare needs in the current Chinese healthcare system. Hence, this study aims to fill this gap by comprehensively evaluating how contracting with FDs affects the unmet inpatient and outpatient healthcare needs of the general population.

Policy background

China's healthcare reforms have made significant progress in addressing systemic inequities, although challenges of affordability and accessibility persisted prior to 2009. Following economic liberalization in the 1980s, hospitals gained more financial autonomy. This shift led to rising healthcare costs and fragmented service delivery. At the same time, aging populations and urbanization further strained the system. Underdeveloped primary care infrastructure funneled many patients into overcrowded urban hospitals, worsening resource disparities (Wu and Shen 2016).

In 2009, a new phase of health reform was launched with the objective of addressing prevailing challenges (State Council 2009). This included initiatives to increase government investment, broaden health insurance coverage, expand essential healthcare services coverage, improve community healthcare facilities, and ensure a reliable supply of medicines. One of the primary objectives of this reform was to implement a tiered medical system (State Council 2009). The structured approach encourages patients to attend primary facilities for initial care, with referrals to higher-tier hospitals when needed.

Central to these efforts, the FDCS was introduced in 2016 to strengthen primary care by connecting residents with multidisciplinary FD teams. These teams provide essential medical services (e.g. consultations, referrals), public health programs (e.g. preventive screenings), and personalized health management (e.g. chronic disease support, traditional Chinese medicine therapies) (State Council 2016, Feng et al. 2020). To incentivize enrollment, the FDCS offers benefits such as prioritized hospital access, higher insurance reimbursements, and flexible care networks (State Council 2016).

In Shandong Province, a densely populated region with diverse demographics, the FDCS offers residents essential medical care, public health services, and customized health management in the form of service packages. These packages are categorized into basic, primary, intermediate, and advanced levels to meet the diverse health needs of the population. Residents usually sign contracts with FDs individually at their local primary healthcare institution. If multiple family members living together are contracting at the same time, they should select the same primary FD team. In areas where medical consortia are piloted or where medical institutions extend to primary healthcare, a '1 + 1' or '1 + 1 + 1' contract model is adopted. This allows primary healthcare institutions to partner with secondary and tertiary hospitals. Contracted residents can choose healthcare facilities within this network according to their needs. Since its introduction in 2016, the FDCS had reached comprehensive coverage at village level by 2020, making Shandong a valuable case study for assessing the effectiveness of such initiatives (Shandong Health Commission 2022).

Method

Data

The primary focus of this study centers on the adult population aged ≥18 years, utilizing data from the sixth round of the National Health Services Survey (NHSS) in Shandong Province. The NHSS has been conducted every 5 years by the National Health Commission of the People's Republic of China starting from 1993 (Zhou et al. 2022). It is a comprehensive, nationally representative survey designed to collect

detailed information on residents' socioeconomic background, health status, healthcare utilization, access to medical services, and health insurance coverage across China. The sixth round of the NHSS was carried out in September 2018 and provides the latest and relevant data related to the FDCS and unmet healthcare needs.

A multi-stage stratified random cluster sampling method was utilized for sample selection for the survey, and eight counties and districts from Shandong province were selected. Within each sample county and district, five sample streets (or townships for rural areas) were randomly selected. Subsequently, two sample resident committees (or villages for rural areas) were randomly selected in each street (or township for rural areas). Ultimately, within each resident committee, 60 households were randomly selected. Face-to-face interviews of the target population were conducted with a tablet by trained interviewers. The target population is the resident population of the sampled households, encompassing all household members and non-household members who have resided in the sampled household within the past 6 months.

The dataset comprises a total of 35 362 observations. As the focus is on the adult population, 7511 samples of those <18 years of age were eliminated from the analysis. Also, observations with missing values in the key outcome variables, treatment variable, and covariates have been excluded, resulting in a final count of 27 447 observations.

Measurements (variables)

The key independent variable is the resident's status with the FDCS, which is captured by their answers to the survey question 'Have you signed up for FD service?'

The dependent variable for this analysis is the residents' unmet needs for both outpatient and inpatient care. Identification of unmet outpatient care needs was based on participants' responses to three specific questions: 'Have you experienced any illness in the past 2 weeks?', 'Have you had an in-person consultation with a doctor for outpatient care to treat the illness?', and 'Have you consulted with a doctor for outpatient care through online platforms (such as hospital websites or applications) to treat the illness?' Individuals were classified as having unmet outpatient care needs if they had been ill within the previous 2 weeks but had not received any medical care from any outpatient healthcare providers. Residents with chronic diseases who actively engage in self-management are not considered to have unmet healthcare needs, even if they have not recently consulted a doctor, as effective self-management, including regular monitoring and adherence to treatment plans, can address the healthcare needs of individuals with chronic conditions.

Likewise, unmet needs for inpatient care were assessed with the following question: 'In the last year, were you advised by a doctor to undergo inpatient treatment, but you did not proceed with hospitalization?' Participants who answered 'yes' were categorized as having unmet inpatient care needs.

All participants with unmet needs were further asked to specify the main obstacle they encountered in obtaining suitable healthcare. For unmet outpatient care, participants were given the following options to choose from: (1) self-perception of mild illness, (2) financial constraints, (3) difficulty attending appointments, (4) time constraints, (5) inconvenient transportation, and (6) lack of effective solutions. According to the United Nation's framework for healthcare access, we categorize respondent-reported barriers through dichotomous variables corresponding to defined dimensions of accessibility, acceptability, and availability (UN Economic and Social Council 2000). Accessibility is defined as non-discriminatory access to healthcare through removal of geographic, financial, informational, and social barriers. Acceptability is generally defined as culturally appropriate, gender-sensitive services adhering to medical ethics, with privacy protections. Availability entails adequate provision of functional health infrastructure, including facilities, essential medicines, and programs, to meet population needs (UN Economic and Social Council 2000). Therefore, we have defined inaccessibility to healthcare services as respondents citing options (2), (4), and (5). Unacceptability is defined by options (1) and (3), while unavailability is defined by option (6). Sociodemographic characteristics, health status, and health-related behaviors are included as control variables to isolate their potential confounding effects.

For unmet inpatient care, participants were given the following options to choose from: (1) self-perception of mild illness, (2) lack of effective solutions, (3) financial constraints, (4) distrust of hospitals, (5) time constraints, (6) long waiting time, and (7) restricted by health insurance. Similarly, based on participants' responses to this question, inaccessibility to healthcare facilities is defined by respondents selecting options (3) and (7). Unacceptability is defined by options (1), (4), and (5), while unavailability is defined by options (2) and (6).

Sociodemographic covariates included age, sex, urban or rural residence, marital status, educational attainment, type of health insurance plans, employment status, and per capita family income. Health status is assessed by an individual's body mass index (BMI) and whether the individual has chronic health conditions. The BMI is calculated from the individual's weight and height. Samples are further categorized into four groups: underweight (BMI < 18.5 kg/m^2), normal weight (BMI 18.5 to less than25 kg/m^2), overweight (BMI 25.0 to less than 30 kg/m^2), and obese (BMI >= 30 kg/m^2) according to the World Health Organization standard. The individual's status on chronic health conditions is retrieved from the questions on whether the individual was diagnosed with hypertension, diabetes, and other types of chronic conditions. Health-related behaviors included smoking status, alcohol drinking status, whether the individual is physically inactive, and whether the participant had a medical check-up in the last 12 months. All covariates are transformed into binary variables through dummy variables for analysis.

Statistical analysis

One significant issue when assessing the effects of the FDCS is the problem of self-selection bias. Individuals who decide to participate in the FDCS may have different sociodemographic characteristics or health-related behaviors compared to those who do not enroll, potentially influencing their healthcare outcomes. For example, individuals contracting with the FDCS may exhibit higher levels of health awareness or have greater access to healthcare resources, which could independently impact their healthcare needs and utilization. This problem of self-selection can result in biases in the estimation of the actual impact of the FDCS on unmet healthcare needs.

To address the self-selection bias, this study utilizes the entropy balancing (EB) method. The EB method adjusts the sample by reweighting it to achieve a balance in covariate distribution between the treatment (residents with FDs) and

control groups (residents without FDs), thereby mimicking the conditions of an independent treatment variable (Hainmueller 2012). Specifically, by fitting weights that adhere to a large set of balance constraints, including precise balance on the first (mean), second (variance), and possibly higher moments of the covariate distributions, EB ensures that the covariate distributions are similar between the treatment and control groups (Hainmueller 2012). Given that adjusting the first moment (mean) of binary covariates is effective in matching their higher moments, and since all covariates in this analysis are binary, it is adequate to reweight the control samples in this study to match with the first moment for the purpose of achieving balance with the treatment group (Hainmueller and Xu 2013). The STATA package *ebalance* was utilized to conduct EB.

After preprocessing the data, given the binary characteristic of the outcome variable, logistic regression models were employed to investigate the average treatment effect of the FDCS on unmet healthcare needs. The regression model used for the analysis is specified as follows:

$$\log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 FDCS + X'\beta$$

where

P is the probability of an individual having unmet healthcare needs (for inpatient and outpatient care):

$$P(Y=1|FDCS, X) = \frac{e^{\beta_0+\beta_1 FDCS+X'\boldsymbol{\beta}}}{1+e^{\beta_0+\beta_1 FDCS+X'\boldsymbol{\beta}}}$$

$FDCS$ is whether the residents have been contracted with FDs, X' is the vector of control variables, including sociodemographic, health status, and health-related characteristics, β_0 is the intercept, β_1 is the coefficient for the key dependent variable $FDCS$, and $\boldsymbol{\beta}$ is the vector of coefficients associated with the control variables.

Given the nonlinearity of the logistic function, the marginal effect of FDCS on the probability of unmet healthcare needs is not constant and varies across individuals depending on their covariates. For this reason, this study reported average marginal effects (AMEs) for the results from logistic regressions. The AMEs of the FDCS across the full sample of size n is calculated as

$$AME_{FDCS} = \frac{1}{n}\sum_{i=1}^{n} \hat{p}_i(1-\hat{p}_i) \times \hat{\beta}_1$$

where $\hat{p}_i$ is the predicted probability of having unmet healthcare needs for individual i, and $\hat{\beta}_1$ is the estimated coefficient on the FDCS.

AMEs reflects the average change in predicted probability associated with a 1-unit increase in the independent variable, holding other variables constant (Williams 2012). As our independent variable FDCS is a binary variable, AMEs in this case represents the average difference in predicted probability of having unmet needs between individuals who are enrolled in the FDCS and those who are not, adjusting for covariates.

To further confirm our main results, this study also employed the matching approach and subsample analysis. Particularly, matching was performed using five different algorithms including nearest neighbor matching, caliper matching without replacement, caliper matching with replacement, kernel matching, and local linear matching. Subgroup analysis was conducted after EB to examine the differential average marginal effects of the FDCS on unmet outpatient care needs across various demographics and health-related factors, including age, gender, residence, and chronic disease conditions.

Additionally, we tested the mechanism underlying our findings. Particularly, how the FDCS has impacted the likelihood of self-reported reasons for unmet outpatient needs was investigated. The empirical strategy is the same as the EB with logit approach except that we replaced the indicator of unmet outpatient healthcare needs with indicators of main reasons for unmet healthcare needs.

Results

Descriptive statistics

Table 1 presents the baseline characteristics of 27 743 adult participants. The prevalences of unmet needs for outpatient care and unmet needs for inpatient care are 13.8% and 3.0% respectively. The mean age of the participants is 50.6 years. The gender distribution in this sample is nearly balanced, comprising 52.1% female and 47.9% male. The educational achievements of participants demonstrate considerable variation: 13.0% of this population have not engaged in any formal education, while 19.5% have completed primary education, and 49.7% have attained secondary education or higher. Most of the participants have enrolled in either commercial or social health insurance plans, while 1.8% of the population is not covered by any form of health insurance. Regarding health status, 57.1% of the participants maintain a normal weight, while 29.9% have chronic diseases. Regarding health-related behaviors, 21.3% are current smokers, 25.5% are current drinkers, and the proportion of inactive individuals is notably high at 52.4%. Additionally, 53.8% of participants had a medical check-up in the last 12 months. Within this sample, 55.3% of residents have signed contracts with FDs. Regarding unmet healthcare needs, 3837 (13.8%) participants reported experiencing unmet outpatient needs, while 820 (3.0%) participants reported unmet inpatient care needs.

Table 2 outlines the different factors contributing to unmet healthcare needs for both registered and unregistered FDCS groups. Among residents having unmet outpatient needs, 27.0% of those enrolled in the FDCS cited inaccessibility as the primary reason for their unmet outpatient care needs, compared to 32.0% of residents not enrolled in the FDCS who cited the same reason. A majority of residents experiencing unmet outpatient needs cited unacceptability as the primary reason in both groups (67.9% and 62.7% respectively). Regarding unmet inpatient needs, 62.8% of residents registered with a FD chose inaccessibility as the primary reason for having unmet outpatient needs, while in the groups without FD registration, the figure is lower at 58.7%.

EB

As mentioned before, the potential existence of endogeneity issues arising from self-selection necessitated additional validation to ensure the robustness of these findings. To address this, EB was utilized to achieve a balanced distribution of covariates across the two groups, ensuring comparability regarding

Table 1. Baseline characteristics of the study participants and proportions of unmet healthcare needs ($n = 27\,743$)

Characteristics	*n*	%	Unmet health needs total[a]	Unmet health needs outpatient	Unmet health needs inpatient
Total	27 743	100	4441 (16%)	3837 (13.8%)	820 (3.0%)
FDCS					
= 0 without FD	12 392	44.7		14.53%	3.33%
= 1 with FD	15 342	55.3		12.96%	2.49%
Age (years)					
18–35	5231	18.86	232 (4.44%)	194 (3.71%)	39 (0.75%)
36–59	13 609	49.05	1781 (13.09%)	1518 (11.15%)	345 (2.54%)
60–79	8127	29.29	2210 (27.19%)	1928 (23.72%)	405 (4.89%)
>80	776	2.80	218 (28.09%)	197 (25.39%)	31 (3.99%)
Sex					
Male	13 292	47.91	2098 (15.78%)	1810 (13.61%)	391 (2.94%)
Female	14 451	52.09	2343 (16.21%)	2027 (14.02%)	429 (2.97%)
Marital status					
Single	1725	6.22	98 (5.68%)	87 (5.04%)	15 (0.87%)
Married	24 259	87.44	3910 (16.12%)	3373 (13.90%)	719 (2.96%)
Widowed	1509	5.44	393 (26.04%)	350 (23.19%)	70 (4.64%)
Divorced	250	0.90	40 (16.00%)	28 (11.20%)	16 (6.40%)
Residence					
Urban	13 893	50.08	2193 (15.78%)	1937 (13.94%)	356 (2.56%)
Rural	13 850	49.92	2248 (16.23%)	1900 (13.72%)	464 (3.35%)
Education attainment					
Illiterate	3600	12.98	876 (24.33%)	745 (20.69%)	183 (5.08%)
Primary	5418	19.53	1166 (21.52%)	998 (18.42%)	224 (4.13%)
Middle school	10 006	36.07	1449 (14.48%)	1271 (12.70%)	255 (2.55%)
High school	4928	17.76	670 (13.59%)	584 (11.85%)	110 (2.23%)
Tertiary	3791	13.66	280 (7.39%)	239 (6.30%)	48 (1.27%)
Employment status					
Employed	16 887	60.87	1968 (11.65%)	1714 (10.15%)	335 (1.98%)
Other status	10 856	39.13	2473 (22.78%)	2123 (19.56%)	485 (4.47%)
Per capita income of household (quartiles)					
Q1 (lower)	6950	25.05	1468 (21.12%)	1221 (17.57%)	332 (4.78%)
Q2	7640	27.54	1072 (14.03%)	915 (11.98%)	200 (2.62%)
Q3	6377	22.99	859 (13.47%)	777 (12.18%)	114 (1.79%)
Q4	6698	24.14	1034 (15.44%)	917 (13.69%)	152 (2.27%)
Health insurance	27 252	98.23	4380 (16.07%)	3785 (13.89%)	805 (2.95%)
BMI					
Underweight	1154	4.16	167 (14.47%)	143 (12.39%)	36 (3.12%)
Normal	15 841	57.12	2276 (14.36%)	1926 (12.15%)	458 (2.89%)
Overweight	9059	32.65	1623 (17.92%)	1443 (15.93%)	263 (2.03%)
Obesity	1689	6.09	375 (22.20%)	325 (19.24%)	63 (3.73%)
Smoking	5909	21.29	864 (14.62%)	752 (12.73%)	152 (2.57%)
Drinking	7084	25.53	1024 (14.46%)	906 (12.79%)	156 (2.20%)
Inactive[b]	14 525	52.36	2294 (15.79%)	1979 (13.62%)	438 (3.02%)
Check-up	14 930	53.80	2778 (18.61%)	2389 (16.00%)	532 (3.56%)
Chronic disease	8297	29.91	3358 (40.47%)	2955 (35.62%)	593 (7.15%)

[a]Number of samples with either unmet outpatient or inpatient needs. [b]Samples who exercised less than once a week over the last 30 days.

the observed characteristics while minimizing self-selection bias. The standard mean differences (SMDs) and the ratios of variance of all 25 covariates before and after reweighting are assessed to examine the effectiveness of EB.

The results are shown in Fig. 1. Before applying EB, the SMDs varied from −0.314 to 0.221, while the variance ratios fluctuated between 0.682 and 2.539. Following the application of EB, the SMDs converged around zero, ranging from −0.0041 to 0.0024, and the variance ratios approached one, ranging from 0.9941 to 1.0027. An absolute SMD centering around zero and <0.2, alongside a ratio of variance approaching 1, is generally regarded as a sign of good balance between treatment and control groups (Austin 2009, Zhang et al. 2019). Hence, our results confirmed that a balanced distribution of covariates is attained, and two groups are comparable following the implementation of EB, thereby enhancing the validity of causal inferences regarding the relationship between signing a contract with a FD and the unmet healthcare needs of residents.

Estimates

The right panel of Table 3 presents the marginal effects results from simple logistic regression with unmatched data controlling for confounders. According to Table 3, a significant and negative association was found between FD registration and unmet outpatient care needs. Specifically, signing up with an FD is associated with lower probability of having unmet healthcare needs by 1.90% compared to those without FD registration {95% confidence interval (CI) [−0.033, −0.004], $P < 0.05$}. Age also showed a notable influence, with the likelihood of unmet outpatient needs increasing as individuals become

Table 2. Reasons for having unmet healthcare needs; residents are classified into two groups based on whether they have registered with FDs

Reasons	FD registration = 1	FD registration = 0
Outpatient	$n = 1608$	$n = 2229$
Inaccessibility	Financial constraints; time constraints; inconvenient transportation	
n (%)	434 (27.0%)	712 (32.0%)
Unacceptability	Self-perception of mild illness; difficulty attending appointments	
n (%)	1092 (67.9%)	1397 (62.7%)
Unavailability	Lack of effective solutions	
n (%)	82 (5.1%)	120 (5.4%)
Inpatient	$n = 309$	$n = 511$
Inaccessibility	Financial constraints; restricted by health insurance.	
n (%)	194 (62.8%)	300 (58.7%)
Unacceptability	Self-perception of mild illness, distrust of hospitals; time constraints	
n (%)	101 (32.7%)	185 (36.2%)
Unavailability	Lack of effective solutions; long waiting time	
n (%)	19 (3.7%)	13 (4.2%)

older. Additional factors associated with higher odds of unmet outpatient needs included urban residence (AME = 0.019, 95% CI [0.005, 0.042], $P < 0.01$), having chronic disease (AME = 0.223, 95% CI [0.203, 0.242], $P < 0.01$), being overweight (AME = 0.010, 95% CI [0.002, 0.019], $P < 0.05$), and obesity (AME = 0.021, 95% CI [0.006, 0.036], $P < 0.01$).

Regarding unmet inpatient care needs, the analysis indicated no significant impact of FD registration (AME = 0.002, 95% CI [−0.004, 0.008], $P > 0.1$). Similar to outpatient needs, age was a significant factor, with older individuals more likely to experience unmet inpatient needs. Higher odds of unmet inpatient needs were also observed among individuals who are divorced (AME = 0.036, 95% CI [0.010, 0.061], $P < 0.01$), have recent medical checks (AME = 0.005, 95% CI [−0.001, 0.011], $P < 0.05$), and have chronic diseases (AME = 0.044, 95% CI [0.037, 0.052], $P < 0.01$). On the other hand, employment (AME = −0.011, 95% CI [−0.016, −0.008], $P < 0.01$), higher family income, and alcohol consumption (AME = −0.010, 95% CI [−0.015, −0.004], $P < 0.01$) were associated with lower odds of unmet inpatient needs.

Logistic regressions were also conducted following reweighting the covariates through EB, and the findings are presented in the left panel of Table 3. For unmet outpatient care needs, the results indicate that individuals who signed up with FDs have a 1.60% lower probability of experiencing unmet outpatient healthcare needs compared to those who did not sign up with FDs (CI [−0.029, −0.003], $P < 0.05$). This negative association aligns with the findings obtained without employing EB, though the average marginal effect is slightly smaller with EB. Similar to the unweighted results, positive associations were observed between unmet outpatient needs and factors such as age, having chronic disease (AME = 0.199, 95% CI [0.180, 0.217], $P < 0.01$), overweight (AME = 0.010, 95% CI [0.002, 0.019], $P < 0.01$), and obesity (AME = 0.016, 95% CI [0.001, 0.031], $P < 0.05$), with slight variations in the level of significance and size of the average marginal effects compared to the unweighted results. Meanwhile, after balancing the covariates in the two groups, the impact of education becomes insignificant.

In contrast, FD registration did not significantly affect unmet inpatient care needs in either method, even after reweighting (with EB: AME = 0.002, 95% CI [−0.004, 0.007], $P > 0.1$). Similar to the unweighted results, males (AME = 0.007, 95% CI [0.002, 0.012], $P < 0.01$), married individuals (AME = 0.016, 95% CI [0.005, 0.036], $P < 0.05$), divorced individuals (AME =0.029, 95% CI [0.006, 0.053], $P < 0.05$), and individuals having chronic disease (AME = 0.040, 95% CI [0.035, 0.046], $P < 0.01$) were associated with higher probability of experiencing unmet inpatient needs. Additionally, lacking health insurance becomes a significant and positive contributor to unmet inpatient needs (AME = 0.017, 95% CI [0.000, 0.034], $P < 0.05$). Conversely, being employed (AME = −0.009, 95% CI [−0.014, −0.004], $P < 0.01$), having higher income, being overweight (AME = −0.005, 95% CI [−0.01, −0.001], $P < 0.05$), and drinking alcohol (AME = −0.009, 95% CI [−0.015, −0.003], $P < 0.01$) were associated with lower probability of having unmet inpatient needs. These results demonstrate that the application of EB reinforces the robustness of the initial findings regarding outpatient care, while also confirming the lack of significant impact of FD registration on inpatient care needs.

Robustness check and potential mechanism

In this section, we confirm the main results using alternative methods and subsample analysis. Table 4 shows the impact of the FDCS on unmet healthcare needs utilizing the matching approach. Specifically, we matched individuals who participated in the FDCS with those who did not, by the same set of individual characteristics as in the EB approach. The matching was performed using five different algorithms: nearest neighbor matching, caliper matching without replacement, caliper matching with replacement, kernel matching, and local linear matching. For a comprehensive explanation of these matching techniques, please refer to Caliendo and Kopeinig (2008). The average treatment effect on the probability of experiencing unmet healthcare needs estimated by the matching approach is generally consistent with our main results in Table 3. Adults having an FD are less likely to experience unmet outpatient healthcare needs. The effects on unmet inpatient healthcare needs are insignificant.

As matching estimators do not alter our main result, we continue to use the EB estimator in the subsample analysis. The results presented in Table 5 revealed notable differences in the impact of the FDCS over various demographics and health-related factors. Regarding age, the reduction in the probability of having unmet outpatient needs was most pronounced for individuals aged 60 to 79 years (AME = −0.025, $P < 0.01$), while an opposite but statistically insignificant effect was observed for those aged ≥80 years, which is likely due to the small sample size in this group. Regarding gender, the impact of the FDCS on males and females was at similar sizes and levels of significance (male: AME = −0.015, $P < 0.05$; female: AME = −0.017, $P < 0.05$). Regarding area of residence, the impact was not significant among urban residents, while for rural residents, the FDCS is significantly associated with lower likelihood of having unmet outpatient needs by 2.6% (AME = −0.026, $P < 0.01$). Lastly, a notable difference was found between individuals with and without chronic diseases. Specifically, enrolling in the FDCS reduced the likelihood of having unmet outpatient needs by 2.6% points for individuals with chronic conditions ($P < 0.01$), which is twice the effect observed for those without chronic diseases.

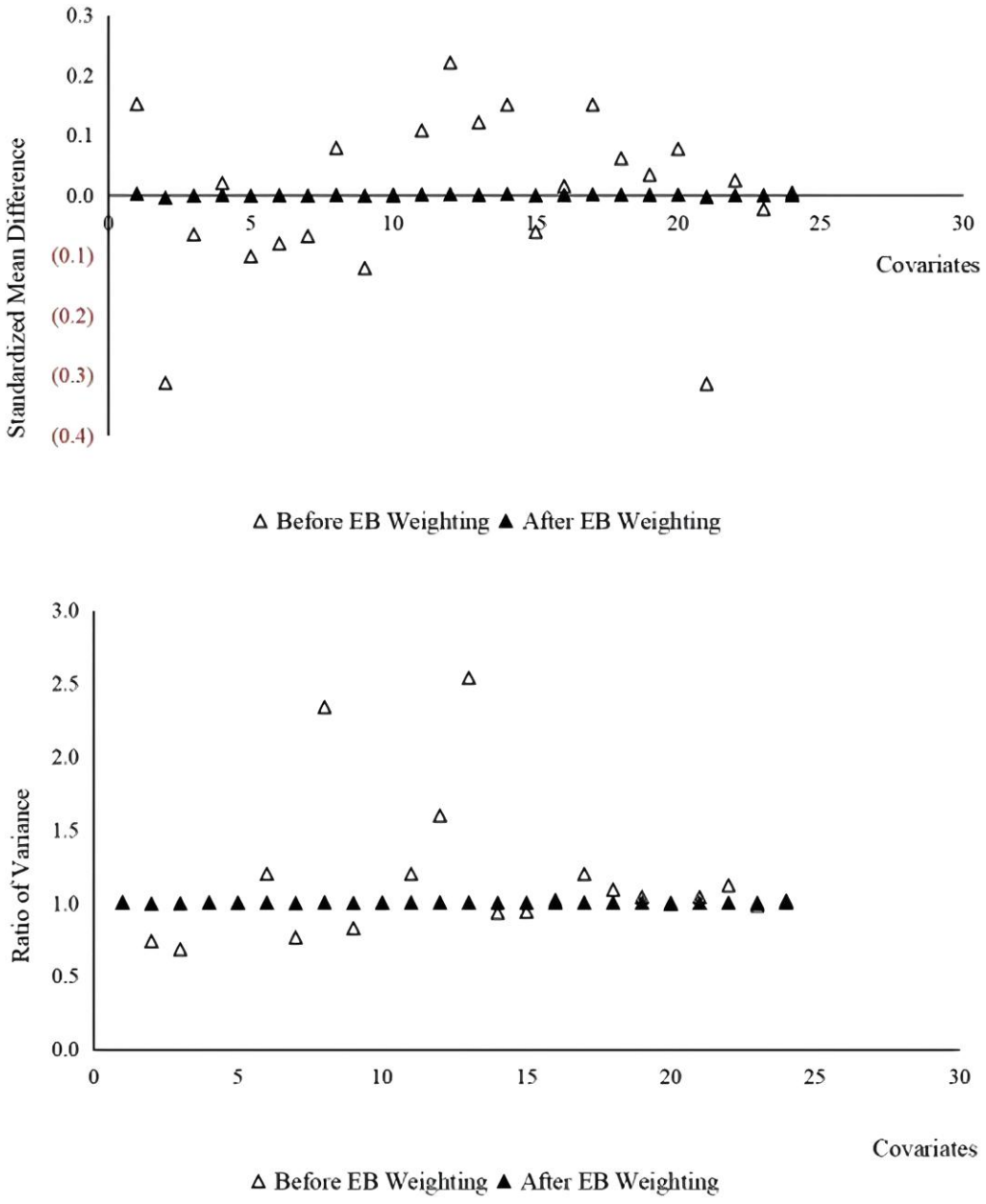

Figure 1. SMDs and ratios of variance of 25 covariates before and after EB. Variables for EB include age 36–59 years, age 60–79 years, age >80 years, male, urban residence, married, widowed, divorced, primary school, middle school, high school, tertiary education, underweight, overweight, obesity, no health insurance, employed, income Q2, income Q3, income Q4, smoking, drinking, physical inactive, health check-up, and chronic diseases.

Regarding the underlying mechanisms, as evident from Table 6, registering with an FD significantly reduced the probability of citing each reason (i.e. inaccessibility, unacceptability, unavailability) as the main reason for unmet outpatient healthcare needs. Among these three reasons, the FDCS has the greatest impact on inaccessibility: signing up with an FD reduced the likelihood of citing this as the main reason for having unmet outpatient care needs by 43.7% points ($P < 0.05$), while the impact on unacceptability and unavailability was relatively more minor at 0.5% points ($P < 0.01$).

Discussion

This study examined the impact of the FDCS on residents' unmet healthcare needs in Shandong Province, China. Findings indicate that enrollment in the FDCS significantly lowers the likelihood of unmet outpatient care needs. This aligns with prior research by Levesque et al. (2012), who established that access to family physicians reduces barriers to care, as well as with studies emphasizing the role of regular healthcare providers in improving service accessibility (Shi and Stevens 2005, Sanmartin and Ross 2006).

The effectiveness of the FDCS in addressing unmet outpatient needs can be attributed to several factors. Firstly, the FDCS enhances the accessibility of healthcare, incentivizing patients to seek care proactively and consistently, thereby addressing outpatient healthcare requirements promptly. By offering more affordable care and being located within local communities, the FDCS is associated with lower probability of delaying care due to cost concerns and makes it easier for

Table 3. Results of reweighted logistic regressions of the effect of FD contracting ($n = 27\,743$)

	EB + Logit				Logit			
	Outpatient unmet healthcare needs		Inpatient unmet healthcare needs		Outpatient unmet healthcare needs		Inpatient unmet healthcare needs	
Variable	AME (95% CI)	SE[a]	AME (95% CI)	SE	AME (95% CI)	SE	AME (95% CI)	SE
FDCS	−0.016** (−0.029, −0.003)	0.007	0.002 (−0.004, 0.007)	0.003	−0.019** (−0.033, −0.004)	0.007	0.002 (−0.004, 0.008)	0.003
Age 36–59 years	0.040*** (0.022, 0.058)	0.009	0.011 (−0.002, 0.024)	0.007	0.044*** (0.024, 0.063)	0.010	0.018 (0.004, 0.032)	0.007
Age 60–79 years	0.064*** (0.043, 0.085)	0.011	0.009 (−0.007, 0.025)	0.009	0.073*** (0.050, 0.096)	0.012	0.013 (−0.004, 0.031)	0.009
Age >80 years	0.072*** (0.040, 0.104)	0.016	−0.001 (−0.021, 0.018)	0.010	0.083*** (0.056, 0.110)	0.017	0.002 (−0.02, 0.023)	0.011
Male	−0.002 (−0.011, 0.008)	0.005	0.007** (0.002, 0.012)	0.003	−0.005 (−0.015, 0.005)	0.005	0.007 (0.002, 0.012)	0.003
Urban residence	0.010 (−0.001, 0.031)	0.011	−0.002 (−0.009, 0.006)	0.004	0.019*** (0.005, 0.042)	0.012	−0.003 (−0.011, 0.006)	0.004
Married	0.004 (−0.023, 0.030)	0.014	0.016** (0.005, 0.036)	0.011	0.001 (−0.026, 0.028)	0.014	0.013 (−0.006, 0.033)	0.010
Widowed	0.000 (−0.031, 0.031)	0.016	0.012 (−0.009, 0.033)	0.011	−0.004 (−0.036, 0.028)	0.016	0.011 (−0.009, 0.032)	0.011
Divorced	−0.010 (−0.054, 0.035)	0.023	0.029** (0.006, 0.053)	0.012	−0.022 (−0.068, 0.024)	0.023	0.036*** (0.010, 0.061)	0.013
Primary school	0.010 (−0.006, 0.026)	0.008	0.001 (−0.004, 0.007)	0.003	0.011* (−0.004, 0.027)	0.008	−0.000 (−0.006, 0.005)	0.003
Middle school	0.009 (−0.007, 0.024)	0.008	0.000 (−0.006, 0.007)	0.003	0.013* (−0.002, 0.029)	0.008	−0.003 (−0.010, 0.003)	0.003
High school	0.010 (−0.009, 0.029)	0.010	−0.001 (−0.009, 0.007)	0.004	0.009 (−0.011, 0.029)	0.010	−0.004 (−0.012, 0.004)	0.004
Tertiary	−0.010 (−0.032, 0.013)	0.011	−0.001 (−0.015, 0.014)	0.007	−0.006 (−0.029, 0.017)	0.012	−0.003 (−0.014, 0.008)	0.006
No health insurance	0.009 (−0.022, 0.04)	0.016	0.017** (0.000, 0.034)	0.009	0.004 (−0.031, 0.038)	0.018	0.009 (−0.006, 0.024)	0.008
Employed	−0.004 (−0.017, 0.009)	0.007	−0.009*** (−0.014, −0.004)	0.003	−0.003 (−0.017, 0.011)	0.007	−0.011*** (−0.016, −0.008)	0.003
Income Q2	−0.008 (−0.021, 0.004)	0.006	−0.004 (−0.012, 0.003)	0.004	−0.007 (−0.020, 0.005)	0.006	−0.005 (−0.013, −0.002)	0.004
Income Q3	0.003 (−0.011, 0.017)	0.007	−0.014** (−0.024, −0.003)	0.005	0.005 (−0.010, 0.020)	0.008	−0.016*** (−0.027, −0.014)	0.005
Income Q4	0.006 (−0.011, 0.023)	0.009	−0.010** (−0.019, −0.001)	0.005	0.005 (−0.015, 0.024)	0.010	−0.011** (−0.020, −0.009)	0.005
Smoking	0.007 (−0.003, 0.017)	0.005	0.000 (−0.005, 0.005)	0.003	0.006 (−0.004, 0.017)	0.005	−0.000 (−0.006, 0.006)	0.003
Drinking	−0.003 (−0.014, 0.007)	0.005	−0.009*** (−0.015, −0.003)	0.003	−0.003 (−0.014, 0.008)	0.006	−0.010*** (−0.015, −0.004)	0.003
Inactive	0.004 (−0.005, 0.013)	0.005	0.001 (−0.003, 0.003)	0.002	0.005 (−0.005, 0.015)	0.005	0.002 (−0.003, 0.006)	0.002
Check-up	0.000 (−0.010, 0.010)	0.005	0.004* (0.0, 0.009)	0.002	−0.000 (−0.011, 0.010)	0.005	0.005** (−0.001, 0.011)	0.003
Chronic disease	0.199*** (0.180, 0.217)	0.009	0.040*** (0.035, 0.046)	0.004	0.223*** (0.203, 0.242)	0.010	0.044*** (0.037, 0.052)	0.004
Underweight	−0.004 (−0.024, 0.017)	0.010	−0.003 (−0.013, 0.006)	0.005	−0.009 (−0.030, 0.013)	0.011	−0.002 (−0.012, 0.008)	0.005
Overweight	0.010** (0.002, 0.019)	0.004	−0.005** (−0.01, −0.001)	0.002	0.010** (0.002, 0.019)	0.005	−0.004* (−0.009, −0.000)	0.002
Obesity	0.016** (0.001, 0.031)	0.007	−0.000 (−0.008, 0.007)	0.004	0.021*** (0.006, 0.036)	0.008	0.000 (−0.007, 0.008)	0.004
Observations	27 743	27 743	27 743	27 743	27 743	27 743	27 743	27 743

[a]SE, Standard Error (standard errors are clustered by villages/communities); *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Table 4. Average treatment effect (ATT) of FDCS on unmet healthcare needs

	Outpatient unmet healthcare needs		Inpatient unmet healthcare needs	
	ATT	SE[a]	ATT	SE
Nearest neighbor	−0.018**[b]	0.007	0.003	0.003
Caliper, without replacement[c]	−0.026***	0.004	0.001	0.004
Caliper, with replacement	−0.018**	0.009	0.002	0.004
Kernel	−0.018**	0.005	0.002	0.004
Local linear	−0.021**	0.009	0.002	0.004

[a]SE, Standard Error. [b]*** $P < 0.01$, ** $P < 0.05$. [c]Caliper width is set to 0.2 of the standard deviation of the logic of the propensity score. Unreported control variables included age 36–59 years, age 60–79 years, age >80 years, male, residence, married, widowed, divorced, primary school, middle school, high school, tertiary education, underweight, overweight, obesity, no health insurance, employment status, family income, smoking, drinking, physical exercise, check-up, chronic diseases.

Table 5. Subgroup analysis of the impact of the FDCS on unmet outpatient care needs

Subgroup	Outpatient unmet healthcare needs	
	AME of FDCS (95% CI)	SE[a]
Age (years)		
18–35	−0.013** (−0.025, −0.000)	0.017
36–59	−0.011** (−0.023, −0.003)	0.007
60–79	−0.025*** (−0.046, −0.005)	0.012
>80	0.040 (−0.105, 0.026)	0.032
Sex		
Male	−0.015** (−0.025, −0.004)	0.005
Female	−0.017** (−0.027, −0.007)	0.005
Residence		
Urban	−0.006 (−0.018, 0.006)	0.006
Rural	−0.026*** (−0.039, −0.016)	0.006
Chronic disease status		
Yes	−0.026** (−0.052, −0.001)	0.013
No	−0.013*** (−0.021, −0.007)	0.004

[a]SE, Standard Error (Standard errors are clustered by village/communities). [b]*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Table 6. Effects of FD registration on reasons for outpatient unmet healthcare needs

	Inaccessibility	Unacceptability	Unavailability
FDCS	−0.437***[a] (0.0014)[b]	−0.057** (0.0028)	−0.0019* (0.0013)

[a]*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$. [b]Standard errors, clustered by villages/communities, are in parentheses; unreported control variables included age 36–59 years, age 60–79 years, age >80 years, male, residence, married, widowed, divorced, primary school, middle school, high school, tertiary education, underweight, overweight, obesity, no health insurance, employment status, family income, smoking, drinking, physical exercise, health check-up, chronic diseases.

residents to utilize the service when required without long travel (Liu et al. 2019, He et al. 2024). This is supported by the findings of this study, which show that registration with FDs is associated with a lower proportion of residents reporting inaccessibility as their primary reason for experiencing unmet outpatient needs. Secondly, the FDCS enhances trust between FDs and their patients. Through receiving continuous and personalized care from the FDs, patients form strong and long-term trusting relationships with their FDs and are more likely to communicate openly regarding health concerns and comply with medical advice and treatment plans (Gu et al. 2019, 2024, Li et al. 2023). Thus, the FDCS plays a vital role in reducing the chances of patients having unmet healthcare needs caused by a lack of trust in the healthcare system and in preventing minor health issues from progressing into more severe conditions. Lastly, the reduction in unmet outpatient needs can be attributed to the emphasis of the FDCS on chronic disease management. The FDCS enables patients to achieve stable health outcomes and increases chronic disease control rates (Li et al. 2023). The provision of FD services has been shown to raise the health-related awareness of chronic disease patients and foster self-management behaviors, hence minimizing the need for urgent medical interventions and decreasing the likelihood of unmet outpatient needs (Lai et al. 2021).

Another notable finding of the study is that the FDCS exhibited heightened effectiveness for vulnerable populations, particularly older adults, rural residents, and chronic disease patients. It echoes studies emphasizing that primary healthcare systems like the FDCS reduce disparities when prioritizing disadvantaged populations (Blumenthal et al. 1995, Starfield et al. 2005, Ferreira et al. 2021). Due to its localized service delivery and population-health focus, the FDCS can effectively target those socioeconomic and environmental determinants of health disproportionately affecting marginalized groups (Marmot et al. 2008, Sacks et al 2020). For instance, the community proximity of FDs enables proactive preventive care and coordinated chronic-disease management, which directly mitigates systemic barriers such as geographic isolation and fragmented healthcare systems.

Overall, the significant reduction in unmet outpatient needs by registering with FDs underscores the importance of the roles of FDs, and policymakers should focus on further educating residents about the benefit of FDs and encourage utilization of the FD service while strengthening the community-based primary care facilities by providing adequate infrastructure, resources, and training.

An interesting finding of this study is the non-significant association between the FDCS and unmet inpatient care needs. Previous studies robustly document that improving primary care access reduces inpatient care utilization (Fortney et al. 2005, Starfield et al. 2005, Nolan, 2011, Ma & Nolan, 2017, Walsh et al. 2019, Zhang et al. 2024). However, healthcare utilization does not mean patients' needs are actually met, nor that no difficulty is experienced in accessing care (Sibley and Glazier 2009, Allan and Ammi 2021). To our knowledge, the specific impact of the FDCS on unmet inpatient care needs remains underexplored in the literature. The non-significant association between the FDCS and unmet inpatient care needs may stem from the system's main focus on primary care services (State Council of the People's Republic of China 2009). Inpatient care generally involves more complicated and severe health issues that require sophisticated diagnostic procedures, specialized treatment, or surgeries, which are often beyond what primary care can offer and are managed at more advanced healthcare facilities instead of CHCs. In the meantime, there is no formal gatekeeping function for FDs, and patients can freely choose secondary and tertiary care without referrals. Therefore, despite that the FDCS contributes to improved outpatient access, its impact on inpatient care access may be constrained.

As there were few studies investigating the association of the FDCS with unmet healthcare needs in China, this study

adds to the existing literature by providing a comprehensive analysis of the impact of the FDCS on both unmet outpatient and inpatient needs. The utilization of EB ensures a good balance of covariate distributions in treated and control groups, allowing the establishment of a causal inference. However, there are several limitations of this study. Firstly, one of the significant limitations influencing the internal validity of the results is the potential impact of the unmeasured and unobserved confounding variables. Although robust matching methods have been employed to mitigate selection bias caused by observed covariates, the presence of unobserved and immeasurable factors, such as health knowledge, health-seeking behaviors, and social support, may differ between the treatment and control groups, potentially resulting in biases in the results. Secondly, this study utilized cross-sectional data with a time frame of 1 year. This data might only reflect short-term effects of the FDCS, limiting the ability to observe the longer-term impacts of the FDCS and examine its sustainability. Also, given there is strong seasonality in healthcare utilization, a single data collection conducted in September may not accurately reflect the annual average level, particularly if the data period encompasses unusual events or seasonal variations (Hamann et al. 2018, Giezendanner et al. 2020).

Several improvements should be considered for future research. Firstly, future studies could utilize longitudinal data to capture the long-term impacts and trends of the FDCS and account for potential seasonality in healthcare utilization. Additionally, expanding the scope of the study to include multiple regions would offer a broader perspective of the FDCS's effectiveness, enabling comparisons across different healthcare infrastructures and demographics, and enhancing the generalizability of the outcomes. Meanwhile, to further enhance internal validity, instrumental variables (IVs) could be employed. For example, the varying implementation dates of the FDCS across regions could serve as a potential IV, as it directly affects whether individuals enroll in the FDCS but is unlikely to directly impact unmet healthcare needs, thus helping to isolate the causal effect of FDCS registration.

Conclusion

Overall, this study revealed that there is a negative association between contracting with FDs and individuals' unmet outpatient needs. Specifically, individuals contracting with FDs are associated with a 1.6% lower probability of experiencing unmet outpatient healthcare needs compared to those who did not sign up with FDs. In contrast, the study showed no significant impact of the FDCS on unmet inpatient needs. The findings highlight the effectiveness of the FDCS in enhancing the role of primary care and improving access to care, and future policy initiatives should prioritize the promotion of the beneficial impacts of the FDCS, raise awareness about its significance, and encourage increased FDCS registrations. However, several limitations exist due to the use of 1-year cross-sectional data with the scope of a single region, potential selection bias from unobserved and unmeasurable covariates, and measurement errors. Subsequent research should aim at assessing the long-term effects of the FDCS, with longitudinal data broadening the geographical focus to encompass multiple regions, and strengthening internal validity with approaches such as IVs to eliminate potential omitted variable bias.

Author contributions

Conception or design of the work: J.T. and J.W. Data collection: P.L. and J.S. Data analysis and interpretation: J.T., L.X., and P.L. Drafting the article: J.T., L.X., and C.C. Critical revision of the article: J.W., C.C., and J.S. All authors approved the final version to be submitted.

Reflexivity statement

In preparing this paper, we have thoughtfully assembled a diverse author team to ensure our work benefits from multiple perspectives and promotes equity in healthcare service and policy research. We believe that by including researchers with different backgrounds, experiences, and viewpoints, the quality and relevance of the research can be significantly enhanced. To this end, we have particularly focused on inclusivity and balance across several dimensions: gender diversity, our author team comprises three male and three female researchers; career stages, our team includes professionals ranging from early-career researchers to senior experts; and geographical distribution, the research is a collaboration by researchers from three institutions in China and the UK.

Ethical approval

Ethical approval for this type of study is not required by our institute.

Conflict of interest

None declared.

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Data availability

The data underlying this article were provided by Shandong Health Commision by permission. Data will be shared on request to the corresponding author with permission of third party.

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