

Addressing Endogeneity in Primary Care Physician Compensation in China: Evidence from an Instrumental Variables Approach

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Abstract

Background

Based on the expected income hypothesis, physicians' desired level of income would affect their behavior. This study aimed at exploring the expected income and explain how primary doctors set their desired income.

Methods

A self-designed survey questionnaire of affecting factors on primary doctors' expected income was extracted from literature reviews and several interviews. The respondents comprised 8,469 primary doctors who participated in the survey (response rate: 52%) in August 2020. The instrumental variables (IV) method was utilized to analyze the factors that impact the expected income of primary doctors.

Results

The average expected income reported by 8,469 PHC workers was \$26,810. It was revealed that the most frequently selected annual expected income bracket was \$24,000-\$48,000, which comprised 41% of the participants. Contrary to the expected income, the most commonly reported actual annual income was between \$4,800 and \$12,000, accounting for 43.5% of the PHC workers. The study found that income levels among PHC workers differed significantly across various regions. Utilizing IV methods, we pinpointed four key factors that significantly influenced the expected income of PHC workers ($P < 0.05$): region, job satisfaction, education level and perceived income.

Conclusion

An incentive-based compensation system is of crucial significance in enhancing the operational efficiency of primary healthcare facilities. Effective compensation management directly reflects the value of primary healthcare staff. As a result, local governments should conduct a strategic assessment of their specific healthcare talent requirements, aligning them with the level of economic development and local circumstances, in order to enhance compensation strategies and attract and retain the necessary talent more effectively to strengthen their healthcare workforce.

1. Introduction

The shortage of well-trained and appropriately distributed health workers, especially in primary health care (PHC), remains a serious challenge to achieving universal health coverage and health equity. Additionally, it is also a global challenge in recruiting and retaining health workers in PHC, which is exacerbated in rural and remote areas[1, 2]. An article published in *The Lancet* in 2019 suggested that

China should improve the competency of primary health care providers by adjusting the incentive mechanism[3]. Despite the government's policy to implement a family registration system, few PHC workers in China are qualified to serve as gatekeepers or provide high-quality PHC services that earn patients' trust[4–6]. Furthermore, due to the limited effectiveness of the incentive system, the problem of 'reverse rate of health service' in China is more prominent, where the primary health care service with the highest demand of residents has the least health manpower[7]. In 2021, hospital health technicians in China accounted for 60.6% of all health technicians, while primary health institutions (including village clinics and community service stations) accounted for only 31.7%[8], facing a significant gap due to the imminent retirement of a large number of village doctors.

To address these challenges, the World Health Organization (WHO) [9] has proposed implementing incentive measures to optimize the supply of qualified primary health workers. The incentive measures aimed at attracting and stabilizing primary health talents primarily include both economic and non-economic incentives. The factors influencing health workers' decision to serve in primary health care include working conditions, salary, career development opportunities, social status and professional honor[10–12]. Significantly improving the salary and welfare of primary doctors is the most effective incentive measure widely adopted by various countries[13–15]. From 2010 to 2017, the salaries of primary doctors in Hungary, Estonia, Luxembourg, Mexico and Canada increased by 8.7%, 5.3%, 4.0%, 3.9% and 3.0% totally, respectively[15, 16]. After the salary increase, 40%-50% of young doctors (including excellent graduates) in the UK are willing to engage in primary health services annually[17, 18]. Additionally, the proportion of Hungarian doctors seeking overseas employment dropped by 10% from 2017 to 2018, and the shortage rate of primary doctors in India fell from 90% to 45%[19]. In addition, many studies indicate that when primary doctors have the same social status and comparable salaries as doctors in large hospitals, it can attract medical graduates and doctors in large hospitals to join the primary health service[20, 21]. The income of most general practitioners in Britain, Cuba, Sweden, and other countries is equal to or even higher than that of specialists[17, 22, 23]. In the United States, as the income gap between general practitioners and specialists widens, the number of family doctors is declining[22].

Based on the expected Income Hypothesis[24], doctors' behaviors are influenced by their expected income levels. If doctors' actual income is lower than their expected income, they may begin making economic decisions to reach their expected income level. If actual income exceeds the expected income level, factors such as occupational status and patient health utility will be considered by the doctor, positively impacting the overall health status of the population. The incentive compatibility theory posits that only by satisfying individual rational needs can incentive strategies encourage individuals to achieve collective goals. When primary doctors receive their expected salary, they are likely to serve longer in primary care institutions and provide improved services. A reasonable salary can also attract more medical professionals to serve at the primary care level.

In China, the income imbalance[25] among primary health doctors is primarily reflected in two aspects. The income of primary health doctors is significantly lower than that of hospital doctors. A

substantial gap exists between the expected income of primary doctors and their current income. Previous studies[26] have indicated that the expected income index for primary doctors is 3.2, suggesting that their current income falls significantly short of their expected income. Prior studies[27] indicate that medical staff, particularly primary health workers, exhibit a high level of dissatisfaction with their income. Therefore, it is essential to examine the income status and expectations of primary doctors and to establish a more equitable salary system to attract and retain primary health workers. This study investigated the income of PHC workers in 12 cities across five provinces in China to ascertain the income status and expected income of PHC workers, as well as the related factors influencing their expected income, thereby providing a basis for establishing reasonable salary levels and enhancing the attractiveness of PHC.

2. Methods

2.1 Questionnaire and variables

A questionnaire was developed based on literature reviews and multiple interviews with primary care doctors. According to the literature review of the expected income hypothesis and the objective of the study, several questions were developed, and semi-structured interviews were conducted with 10 primary care doctors. A self-designed questionnaire was created based on the findings from these interviews[28]. The questionnaire consisted of two sections: 'demographic and practice characteristics of the primary doctors' and 'primary doctors' perspectives on factors influencing their expected income. The following section illustrates the variables from part 2 that require further explanation:

Expected Income

The 'expected income' variable was evaluated using the following question:

Considering your efforts to attain your current professional status, living expenses, and technical expertise, what do you regard as an appropriate annual income from your healthcare practice?

Perceived Income

This variable was evaluated with the following question: 'If you hold a doctor license and a bachelor's degree, what annual income would incentivize you to work in primary health institutions?'

Satisfaction with Current Professional Work Status

This variable was evaluated with the following question:

Overall, are you satisfied with your current work status?

Very satisfied, satisfied, moderately satisfied, somewhat dissatisfied, very dissatisfied.

2.2 Data collection

A cross-sectional survey was conducted in August 2020. It was reviewed and approved by the ethics committee of Nanjing Medical University (NMU-ER(2020)589). All participating PHC workers were informed that the survey was conducted exclusively for research purposes and bore no relevance to any individual performance evaluation. The questionnaire was designed to be anonymous and voluntarily completed, thereby ensuring the objectivity of the self-assessment. A combination of multi-stage stratified cluster sampling and typical sampling was adopted in the survey, targeting PHC workers across the eastern, central, and western regions of China. First, two provinces in each of the three regions were selected as sample provinces, based on health policies for primary health development and substantial progress in primary health care. Second, two prefectural cities were chosen per province on the basis of their intermediate economic performance and primary health facility development. The same standards governed the further selection of one municipal district and one county within each city. All PHC workers employed at primary health organizations—including community health service centers, community health service stations, township health centers and village clinics were enrolled in the survey. Due to restrictions around COVID-19, only one province in the east was investigated, and the sample size doubled. A total of 8,469 PHC workers from the sampled institutions were included. An online questionnaire survey was conducted among PHC workers in the selected areas.

Inclusion Criteria

The survey objects of this study are doctors working in all primary health institutions (community health service centers, community health service stations, township health centers and village clinics) in the samples, including specialists, general practitioners, village doctors and public health doctors.

2.3Data analysis

In this study, the instrumental variable (IV) approach was employed to eliminate the endogeneity of the explanatory variables. Actual income is one of the primary explanatory variables, it is determined simultaneously with expected income. Additionally, actual income is subject to measurement error because the result is self-reported by PHC workers. Therefore, both the endogeneity of actual income and its measurement errors were addressed using the IV approach in this study.

In the IV approach, the selection of appropriate instrumental variables is crucial. An instrument (V) is a variable that is uncorrelated with the error term (U) of model but correlated with the endogenous explanatory variable (X). Therefore, we choose the variables related to the endogenous explanatory variable—actual income as the instrumental variables. These instruments consisted of 'Practice experience' 'age' and 'gender'.

Based on the literature and questionnaire surveys with PHC workers, the determinants of expected income were classified into three categories: demographic variables, practice variables, and physicians' perceptions. The demographic variables include region, education level and professional title. The practice variables consist of actual income, practice setting and Bianzhi. The variables reflecting the views of PHC workers comprised 'job satisfaction' and 'perceived income.'

Therefore, the model can be expressed as follows:

$L_{\text{expected income}} = f(\text{actual income, region, education level, professional title, practice setting, Bianzhi, job satisfaction and perceived income})$.

expected income and perceived income were entered in the model in logarithmic form. expected income and perceived income were converted into U.S. dollars using Purchasing Power Parities (PPP) for the study years (OECD National Accounts Statistics: PPP).

The final model was estimated using both the instrumental variable (IV) approach and ordinary least squares (OLS). Each method within the IV approach has its own implications, strengthens and weaknesses. For example, the two-stage least squares estimation (2SLS) allows for the integration of multiple IVs into one optimal IV, so that it can be applied to the IV estimator. When the instrumental variables are weak, the limited information maximum likelihood (LIML) method, which is less sensitive to weak IVs, can be employed. Additionally, the generalized method of moments (GMM) accounts for heteroskedasticity in the error terms. Therefore, the two-stage least squares(2SLS), limited information maximum likelihood (LIML) and generalized method of moments (GMM) were used for estimating the model in this study.

Data were cleaned and analyzed using STATA 16. Cross-tabulation was used to compare the actual income and perceived income of PHC workers in different regions. Data on the average annual wages of employees from each region, sourced from the 2020 Statistical Yearbook, were compared with the expected income of PHC workers across different regions to reflect how PHC workers' income aligns with that of other professions.

3. Results

The demographic information and work conditions of the 8,469 respondents are presented in Tables 1 and 2. The mean age of the participants was 43 years, and 48.8% had practiced for over 21 years. Only 39.2% of respondents reported being satisfied with their job.

Table 1
Demographic information of PHC workers in China(n = 8469)

Category	Subcategory	Urban		Rural		Total	
		N	%	N	%	N	%
Age(years)	< 30	314	11.0	428	7.6	742	8.8
	30–45	1467	51.2	2303	41.1	3770	44.5
	45–60	990	34.6	2617	46.7	3607	42.6
	>=60	92	3.2	258	4.6	350	4.1
Gender	Male	1285	44.9	3462	61.8	4747	56.1
	Female	1578	55.1	2144	38.2	3722	43.9
Region	East	1242	43.4	1711	30.5	2953	34.9
	Middle	1097	38.3	2103	37.5	3200	37.8
	West	524	18.3	1792	32.0	2316	27.3
Education level	High school or below	548	19.1	2714	48.4	3262	38.5
	Junior College	861	30.1	1479	26.4	2340	27.6
	Undergraduate and above	1454	50.8	1413	25.2	2867	33.9
Professional title	None	473	16.5	2108	37.6	2581	30.5
	Primary	1180	41.2	2423	43.2	3603	42.5
	Intermediate	863	30.1	764	13.6	1627	19.2
	Senior	347	12.1	311	5.5	658	7.8

Table 2
Work condition of PHC workers in China(n = 8469)

Category	Subcategory	Urban		Rural		Total	
		N	%	N	%	N	%
Institutional Type	Community health center	1506	52.6	496	8.8	2002	23.6
	Community health service station	225	7.9	246	4.4	471	5.6
	Township health centers	456	15.9	1529	27.3	1985	23.4
	Village clinics	624	21.8	3292	58.7	3916	46.2
	Other institutions	52	1.8	43	0.8	95	1.1
Bianzhi	Formal	1294	45.2	1762	31.4	3056	36.1
	Personnel agent/rural doctor	661	23.1	3205	57.2	3866	45.6
	Others	908	31.7	639	11.4	1547	18.3
Practice experience	0–5 years	343	12.0	512	9.1	855	10.1
	6–10 years	509	17.8	643	11.5	1152	13.6
	11–15 years	406	14.2	487	8.7	893	10.5
	16–20 years	412	14.4	1025	18.3	1437	17.0
	21 > years	1193	41.7	2939	52.4	4132	48.8
Job satisfaction	Very satisfied	214	7.5	582	10.4	796	9.4
	Moderately satisfied	896	31.3	1628	29.0	2524	29.8
	Neutral	1196	41.8	2145	38.3	3341	39.4
	Moderately dissatisfied	470	16.4	993	17.7	1463	17.3
	Very dissatisfied	87	3.0	258	4.6	345	4.1

Table 3 summaries the distribution of actual, expected and perceived annual incomes. The average expected income was \$26,810, with the most frequently selected bracket being \$24,000–\$48,000, which comprised 41% of the participants. In contrast, the most commonly actual annual income was \$4,800 - \$12,000, accounting for 43.5% of the workers. Among urban PHC workers, 39.9% earned \$12,000 - \$24,000, the highest proportion in that category. By comparison, the majority of rural PHC workers (47.1%) earned \$4,800- \$12,000 per year, confirming a persistent urban–rural income gap.

Table 3
Characteristics of PHC workers' annual income in China(n = 8469)

Category	Subcategory	Urban		Rural		Total	
		N	%	N	%	N	%
Actual income(USD)	< 4800	302	10.5	1138	20.3	1440	17.0
	4800–12000	1046	36.5	2642	47.1	3688	43.5
	12000–24000	1142	39.9	1468	26.2	2610	30.8
	24000–36000	340	11.9	312	5.6	652	7.7
	>=36000	33	1.2	46	0.8	79	0.9
Expected income(USD)	< 12000	183	6.4	576	10.3	759	9.0
	12000–24000	767	26.8	2203	39.3	2970	35.1
	24000–48000	1281	44.7	2195	39.2	3476	41.0
	48000–71000	512	17.9	496	8.8	1008	11.9
	>=71000	120	4.2	136	2.4	256	3.0
Perceived income(USD)	< 12000	80	2.8	263	4.7	343	4.1
	12000–24000	529	18.5	1440	25.7	1969	23.2
	24000–48000	1474	51.5	2865	51.1	4339	51.2
	48000–71000	632	22.1	808	14.4	1440	17.0
	>=71000	148	5.2	230	4.1	378	4.5

Combined with Table 3, which shows urban-rural disparities, Table 4 reveals a clear east-west gradient in actual income. In the eastern region, the largest proportion (47.6%) earned \$12,000-\$24,000. By contrast, the majority of workers in the middle and western regions were concentrated in the lower brackets of \$4,800-\$12,000 (55.0% and 50.0%, respectively) and below \$4,800 (22.7% and 20.8%, respectively). Only a negligible fraction in the middle and western regions reached \$24,000 or above, whereas 18.2% of eastern workers earned \$24,000-\$36,000. These findings quantify a clear east-west gradient in actual compensation, with eastern PHC workers enjoying a higher income distribution.

Table 4
Actual annual income for PHC workers based on regions(USD)

Region	< 4800		4800–12000		12000–24000		24000–36000		>=36000	
	n	%	n	%	n	%	n	%	n	%
East	239	8.1	770	26.1	1407	47.6	474	16.1	63	2.1
Middle	718	22.7	1760	55.0	581	18.2	129	4.0	12	0.4
West	483	20.8	1158	50.0	622	26.8	49	2.1	4	0.2

Table 5 presents the perceived annual income, defined as the minimum income that respondents considered necessary to attract a qualified primary care doctor (holding a medical license and a bachelor's degree or higher) to work in primary care. The overall mean perceived income was \$31,786. A clear regional gradient was observed, with the highest perceived income in the east (\$36,738), followed by the central region (\$29,880) and the west (\$28,108). Across all regions, urban respondents consistently reported higher perceived income levels than their rural counterparts. The urban-rural gap was largest in the west, (\$5,308, 19.7%), smaller in the central region (\$2,428, 8.4%) and smallest in the east (\$1,928, 5.4%). Notably, urban perceived income in the west (\$32,208) exceeded that of the central region (\$31,475), whereas rural perceived income in the west (\$26,900) was substantially lower than that in the central region (\$29,047). This pattern indicates greater within-region heterogeneity in the west, driven by a higher urban expectation but a lower rural expectation relative to the central region.

Table 5
Perceived income of a qualified PHC worker based on different regions (USD)

Region	Urban		Rural		Total	
	N	Mean	N	Mean	N	Mean
East	1242	37857	1711	35929	2953	36738
Middle	1097	31475	2103	29047	3200	29880
West	524	32208	1792	26900	2316	28108
Total	2863	34357	5606	30452	8469	31786

Factors that influence PHC workers' expected income

Table 6 reports the regression estimates from ordinary least squares (OLS) and three instrumental variable (IV) methods: two-stage least squares (2SLS), limited information maximum likelihood (LIML) and generalised method of moments (GMM). Across the IV methods, the coefficients for actual income were consistent (0.50–0.54), whereas the OLS coefficient was 0.16. All four models were statistically significant ($P < 0.01$). The first-stage F-statistic for actual income was 28.6 ($P < 0.001$), indicating no weak instrument problem.

The IV methods identified four main factors significantly influenced expected income ($P < 0.05$): region, job satisfaction, education level and perceived income. Region was positively associated with expected income, with eastern physicians holding higher expectations. Job satisfaction was negatively associated: workers dissatisfied with their current environment tended to have higher income expectations. Perceived income had the strongest positive effect, with an elasticity of approximately 0.54. Education level also showed a positive association, though its coefficient became non-significant in the IV models, suggesting possible collinearity with actual or perceived income.

The expected income of PHC workers is significantly influenced by geographical location, with those in eastern regions demonstrating higher remuneration expectations. This trend is exacerbated by the varying levels of economic development across the regions. In these eastern regions, the higher cost of living naturally results in elevated income expectations, necessary to meet basic living needs.

Furthermore, job satisfaction significantly influences the income expectations of PHC workers. Specifically, PHC workers who are dissatisfied with their current working environment tend to have higher income expectations.

The literature review indicates that the primary reasons for job dissatisfaction among PHC workers include low remuneration, increased work-related stress, and limited opportunities for career advancement. As a result, physicians with reduced job satisfaction set higher income expectations as a means to mitigate their dissatisfaction with primary healthcare practice.

Additionally, physicians' perceived income exerts a significantly positive influence on their income expectations. In this context, the term 'perceived income' refers to the threshold income required to attract duly qualified doctors with a bachelor's degree or higher, and possessing the requisite medical qualifications to work in primary care. This also highlights the correlation between educational attainment and income expectations among PHC workers, as those with higher educational qualifications tend to have proportionally higher income expectations.

Table 6
Estimates of determinants of expected income for PHC workers using the IV approach and OLS (P-value in parentheses)

	IV methods			
	OLS	2SLS	LIML	GMM
Constant	-0.0960** (0.038)	-0.682*** (0.241)	-0.728*** (0.266)	-0.672*** (0.238)
Actual income	0.150*** (0.007)	0.509*** (0.143)	0.537*** (0.158)	0.500*** (0.141)
Region	0.0008 (0.005)	0.0586** (0.023)	0.0630** (0.026)	0.0572** (0.023)
Practice setting	-0.0286*** (0.000)	0.0119 (0.465)	0.0146 (0.409)	0.0121 (0.458)
Job satisfaction	0.0269*** (0.004)	0.0705*** (0.018)	0.0739*** (0.020)	0.0693*** (0.018)
Education level	0.0732*** (0.006)	0.0171 (0.024)	0.0128 (0.026)	0.0187 (0.023)
Professional title	0.0574*** (0.006)	0.0110 (0.019)	0.00742 (0.021)	0.0118 (0.019)
Bianzhi	-0.0277*** (0.005)	0.0285 (0.023)	0.0328 (0.026)	0.0276 (0.023)
L perceived income	0.712*** (0.014)	0.541*** (0.078)	0.528*** (0.079)	0.547*** (0.078)
N	8469	8469	8469	8469
R ²	0.761	0.633	0.612	0.639
p-values in parentheses				
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$				

4. Discussion

The results of our survey demonstrate that, approximately 43.5% of PHC workers currently earn between \$4,800 and \$12,000 annually, while 41% expect an annual income exceeding \$24,000, which would effectively double their current earnings. Additionally, job satisfaction among PHC workers does not exceed 50%, with a rate of 39.2%. This finding was consistent with the previous results[29, 30]. This highlights the dissatisfaction of PHC workers with their current income, which falls below their expectations. This clearly indicates that current income standards for PHC workers are inadequate for attracting and retaining healthcare professionals.. Income remains a central issue in healthcare. Prior research found a correlation between physicians' job satisfaction and patients' satisfaction with the quality of medical care[31, 32]. High physician job satisfaction has been shown to help patients reduce expenses and achieve better health outcomes. Compared to those with lower job satisfaction, physicians with higher satisfaction may deliver more effective care and treatment[30]. Income is perceived as a critical factor affecting job satisfaction, recruitment, and the retention or migration of physicians both within and across regions.[33, 34].

Regional disparities significantly influence the expected income of PHC workers. Significant variations in income expectations exist across provinces, with a general decline observed from eastern to western regions. In particular, PHC workers in eastern regions report higher income expectations. Additionally, income expectations differ between urban and rural areas, with urban PHC workers typically holding higher income expectations than their rural counterparts. This is primarily influenced by the economic development level of each region, which directly impacts the income expectations of PHC workers. Regions with rapid economic growth tend to have higher per capita income levels. In these regions, healthcare practitioners operate within social environments with higher standards of living, which in turn fosters higher income expectations. Affluent and developed regions are well-known for their abundance of medical resources and state-of-the-art facilities, creating ample employment opportunities under favorable conditions. As a result, PHC workers in eastern regions and urban areas hold higher compensation expectations, reflecting both their substantial contributions to healthcare and the intrinsic value of their services[25]. Furthermore, areas with higher living costs and consumption levels naturally present higher income expectations. Therefore, emphasizing the recruitment of local physicians can serve as a key strategy for workforce stability in primary care organizations within central and western regions. In central and western areas, many targeted training programs are conducted within higher education institutions, where graduates returning to their local communities to embark on their professional careers upon program completion. This ongoing process significantly fosters the development of local medical expertise[35].

In terms of actual income, it becomes evident that the majority of urban PHC workers earn a higher income compared to their rural counterparts. Urban areas tend to have a more abundant supply of medical resources, advanced health facilities and a wider array of medical service providers. In this context, physicians in urban areas have more opportunities to provide a wider range of higher-quality health services, leading to increased income levels. Additionally, urban areas, characterized by larger populations and a heightened demand for health services, typically impose a higher patient load and workload on PHC workers[36]. This substantial variance in healthcare resources, workload and cost of

living between urban and rural areas explains the corresponding disparity in income expectations. Consequently, urban PHC workers understandably hold higher income expectations, reflecting the distinct challenges and opportunities associated with urban health practice[37]. Conversely, PHC workers in remote and rural areas, despite having lower salary expectations, have specific needs for benefits and working conditions. In remote rural regions, alongside direct remuneration, fringe benefits such as housing support and professional development opportunities are often provided to improve these practitioners' quality of life and job satisfaction. At the same time, it is imperative to strengthen the local recognition and esteem of primary care physicians, thereby enhancing their social standing and intrinsic value within the community. Fostering a stronger sense of belonging and job satisfaction among grassroots healthcare providers can significantly reinforce their commitment to primary care service.

From the perspective of perceived income, it becomes apparent that an annual income of \$31,786 serves as an attractive threshold for attracting appropriately qualified doctors with the necessary medical qualifications and a bachelor's degree or higher to work in primary care. This figure highlights a considerable gap between the current actual income levels of PHC workers and the desired standard for attracting qualified professionals. Understanding the income expectations of qualified physicians is essential for developing informed recruitment and retention policies in primary care. The influence of educational attainment on PHC workers' income expectations is particularly pronounced in terms of perceived income. Higher educational attainment is consistently associated with elevated income expectations. This trend can be attributed to multiple factors. In terms of perceived professional value, it is generally observed that primary care physicians possessing advanced educational qualifications hold a distinct advantage in medical knowledge and professional competence. This higher level of expertise provides these professionals with an enhanced sense of value within the medical field, which justifies adequate remuneration for their skills and expertise[38]. Additionally, the pursuit of medical education generally requires significant investments of both time and financial resources. As a result, primary care physicians with higher education often demonstrate a consistent commitment to their educational and professional development. This dedication, in turn, strengthens their expectation of higher remuneration, reflecting the significant personal investment made in their professional growth.

PHC workers with advanced educational backgrounds possess enhanced clinical skills and, often, higher social status, which naturally foster expectations of greater remuneration. Internationally, particularly in developed countries, physicians typically receive higher pay than many other professions and benefit from comprehensive social security systems that reinforce professional values and service quality[39, 40]. However, despite the wide-ranging and socially valuable responsibilities of PHC workers-including primary care delivery, disease management, public health initiatives, and health education-their current compensation rarely matches the scope of their contributions or the demanding workload. This imbalance is especially pronounced among those with lower job satisfaction, who tend to hold even higher income expectations. Such expectations are legitimate, given the physicians' deep commitment to patient welfare and the substantial personal investment in years of dedicated education and

training[41]. Therefore, enhancing both income and non-financial benefits for PHC workers is essential to attract and retain skilled talent.

5. Conclusion

In summary, it is essential for relevant authorities to carefully assess the fundamental needs of PHC workers and implement a well-structured system of incentives and protections. Compensation reforms should be region-specific: eastern and urban areas may require higher base salaries to align with perceived income thresholds, whereas western rural regions could benefit from moderate salary increases paired with non-financial benefits such as housing support, professional development, and community recognition. Given that perceived income strongly anchors expectations, publishing competitive salary benchmarks could help recalibrate those expectations and attract talent. Moreover, enhancing job satisfaction through workload management and well-defined career progression pathways may reduce the upward pressure on expected income. Local governments should strategically assess their healthcare workforce needs based on local economic development levels and design incentive-based remuneration packages that not only raise salaries but also address non-monetary determinants of job satisfaction. Only by aligning compensation with the perceived value of primary care work can China effectively attract and retain the skilled workforce needed to strengthen its primary healthcare system.

Declarations

Ethics approval and consent to participate

The studies involving humans were approved by the Ethics Committee of Nanjing Medical University (NMU-ER (2020) 589). All procedures were performed in accordance with the Declaration of Helsinki and applicable national laws and institutional regulations. Written informed consent to participate in this study was not required from the participants in accordance with the national legislation and the institutional requirements. A selfassessment questionnaire was completed by participants. Verbal informed consent was obtained from all respondents before the interviews.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

DH and JZ have made substantial contributions to conception and design, SQL and DH interpretation of data and wrote the first draft of the manuscript. JZ revised it critically for important intellectual content and gave final approval of the version to be published. Each author participated sufficiently in the work to take public responsibility for appropriate portions of the content. All authors read and approved the final manuscript.SQL and DH contributed equally to this work and should be considered co-first authors.

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Data Availability

The datasets used in this study are not publicly available due to a confidentiality policy, but they are available from the corresponding author upon the agreement from the research team.

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