

The impact of perceptual bias on the utilization of home- and community-based services among older adults in China

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Research Article

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Abstract

Background

Aging in place is the dominant mode of care for older adults in China, and extensive national efforts have expanded home- and community-based services (HCBS). However, rapid growth in supply has not translated into effective utilization, leaving many needs unmet and resources underused. Existing research often overlooks older adults' perceptions of service availability, which may introduce selection bias and contribute to inconsistent findings. This study introduces the concept of perceptual bias, examines its mechanisms, assesses its influence on HCBS utilization, and explores strategies to mitigate bias and improve service uptake.

Methods

Guided by perceptual bias theory, an analytical framework was developed and applied to survey data from 28 communities and 943 older adults in Shaanxi, Hubei, and Zhejiang provinces. Binary logistic regression was used to test the effect of perceptual bias on the utilization of four HCBS types: healthcare, family-substitute, disability care, and personal assistance services. A two-stage Heckman model identified the determinants of perceptual bias across information sources, transmission, and acquisition, and then estimated the effects of health status, family caregiving capacity, and socioeconomic resources on HCBS utilization while correcting for selection bias.

Results

Perceptual bias significantly affected the utilization of all four service types. Its formation was shaped by community type and location, as well as by individual characteristics including age, health status, living arrangement, and pre-retirement occupation. After correction for selection bias, perceptual bias constrained rural older adults' access to healthcare services, misdirected family-substitute services away from their intended target groups, exacerbated shortages of disability care, and reinforced reliance on low-level personal assistance services, resulting in inefficient resource allocation.

Conclusions

Perceptual bias constitutes a critical yet under-recognized barrier to HCBS utilization. Recommended measures include proactive outreach to disadvantaged groups, improved accessibility of disability care services, and strengthening of the quality of rural HCBS provision.

1. Background

In 2000, China had 88.21 million people aged 65 years and above, accounting for nearly 7% of the total population and approaching the United Nations threshold for an aging society. In the same year, the State Council issued the Notice on Accelerating the Socialization of Social Welfare, proposing a development direction that prioritizes home-based care, relies on community-based care, and is supplemented by institutional care. The stated goal was that by 2005 China would “basically establish a social welfare service network consisting of state-run welfare institutions as models, various types of welfare institutions as the backbone, community welfare services as support, and home-based care as the foundation.” Since then, aging in place has become the predominant mode of care for older adults in China, with only 2.87% residing in care, nursing, or medical institutions.

H (HCBS) substantially promote the health and well-being of older adults living at home and have received strong political attention and support from the central government [1]. From 2000 to 2023, the State Council and relevant ministries issued 834 policy documents related to HCBS—such as the Healthy China 2030 Plan, the Medium- and Long-term Plan for Actively Responding to Population Aging, and the Opinions on Advancing the Basic Care Service System—and allocated significant financial, material, and human resources to accelerate construction of the HCBS system. By the end of 2022, 363,000 community-based care facilities for older adults were in operation nationwide, providing 3.058 million beds. In Shaanxi Province, 17,800 care institutions and facilities had been established; day-care centers covered 93.8% of urban communities, and “mutual-aid happiness centers” covered 82% of administrative villages[2].

However, the rapid growth of HCBS supply has not led to effective utilization. Many HCBS facilities and programs exhibit low utilization and significant resource underuse [3]. Surveys show that 20% of older adults had never used any HCBS, and 92.75% of disabled or semi-disabled older adults had never heard of relevant HCBS programs [4].

To address the problem of low utilization of HCBS, many studies have used survey data to analyze the determinants of service use among older adults. Existing research generally attributes HCBS utilization to three dimensions: individual-level factors such as health status and income; interpersonal-level factors such as family and social support; and community-level factors such as service quality, supply capacity, and urban–rural disparities. For example, Yang et al. [5] found that service utilization is significantly associated with health status; Wang and Di [6] reported that subjective relative income positively affects utilization; Zhang and Hu [7] highlighted the role of formal and informal social support; and Yu et al. [8] and Che and Cheung [9] demonstrated that community supply plays a key role in shaping service use.

Substantial debate remains regarding the primary causes of low utilization. On the demand side, some studies argue that income largely reflects payment capacity and thus constitutes a prerequisite for using HCBS[3, 10], whereas others find that personal savings among rural older adults exert a negative effect on utilization[11]. On the supply side, Di et al. [12] contended that service accessibility is critical for

promoting HCBS uptake, whereas Yu et al. [8] reported that accessibility does not significantly influence utilization among older adults living at home.

A key limitation of these studies is that they treat service utilization as the dependent variable without explicitly distinguishing whether older adults correctly perceive the availability of community-based services. If older adults are unaware of the services provided in their community, utilization cannot occur in the first place. This source of selection bias may explain the conflicting findings in existing research. Therefore, this study examines HCBS utilization from the perspective of perceptual bias.

The term “perceptual bias” originates from social psychology and refers to discrepancies between individuals’ subjective understanding of various social attributes and the objective reality at the societal level, arising from limits in individual cognitive scope and information access [13]. This phenomenon is widely observed in socio-economic contexts and has therefore been applied across multiple domains within the social sciences. Within the domain of public services, perceptual bias remains a relatively new analytical concept and has primarily been used in studies of policy perception. For example, Tang and Zheng [14], in examining the “involution” of the Farm Book House policy implementation, employed perceptual bias to illustrate the gap between policy coverage and public awareness among rural residents. Research on HCBS from the perspective of perceptual bias remains limited. Consequently, analyses of the determinants of HCBS utilization among older adults may suffer from omitted-variable bias, leading to biased conclusions.

Correct perception of HCBS constitutes a necessary precondition for utilization. To address the absence of perception-related mechanisms in existing research, this study focuses on three questions: first, whether perceptual bias affects HCBS utilization; second, what factors contribute to the formation of perceptual bias; and third, how service utilization among older adults aging in place can be improved.

Taken together, the existing literature has developed along three largely separate strands—individual attributes such as health status and income, interpersonal and family caregiving resources, and community-level supply and accessibility—each modelled as a direct determinant of a binary utilization outcome. What these strands share, and what remains unaddressed, is an implicit assumption that older adults accurately perceive the services available to them; none has treated awareness itself as a variable to be measured and modelled. By explicitly incorporating perceptual bias as an intervening mechanism between service supply and utilization, and by using a two-stage Heckman framework to correct for the selection that unawareness induces, this study extends the existing demand-side literature: it reframes low utilization as partly an information and cognition problem rather than solely a resource or accessibility problem, and it offers a testable explanation for why the three existing strands often yield inconsistent findings across settings.

2. Methods

2.1 Analytical framework

Perceptual bias theory posits that the failure of target populations to accurately perceive publicly provided services is influenced by factors across three stages: the information source, channel, and receiver. The framework is shown in Fig. 1.

Service providers also serve as information sources. The process of service provision is simultaneously a process through which service-related information is generated. Therefore, the supply capacity of HCBS providers influences the generation of information sources.

The effectiveness of communication channels is influenced by distance, which includes both physical and cognitive dimensions. Physical distance primarily reflects the geographic separation between older adults' residences and HCBS facilities. Due to spatial disparities in HCBS coverage, older adults living farther from service facilities are generally less likely to obtain information about available services.

Cognitive distance refers to older adults' familiarity with their local community. There are substantial differences among older adults in their understanding of the communities in which they live. When service-related information is transmitted to older adults with a higher level of community familiarity, the degree of information asymmetry will typically be lower.

Older adults are the final receivers of information regarding HCBS provision. Individual characteristics may not directly influence service utilization; instead, they may first shape older adults' perceptions of service availability and subsequently affect utilization behavior indirectly through these perceptions.

Under the influence of information sources, channels, and receivers, older adults may exhibit either accurate perceptions or perceptual bias regarding HCBS provision. The utilization of a specific service is possible only when that service is available within the community and its availability is correctly perceived by older adults. Therefore, accurate perception serves as a necessary condition linking service provision to service utilization.

Based on this framework, three empirical questions are examined. First, the determinants of perceptual bias are identified. Second, the study investigates whether perceptual bias generates selection bias in HCBS utilization. Third, after correcting for the effects of perceptual bias, the determinants of HCBS utilization are estimated.

2.2 Participant recruitment

The data for this study were obtained from the field research of the subject team in 2022, which was composed of 24 teachers, doctoral students, and master's students. A six-layer stratified random sampling design was employed. First, Shaanxi Province in the west of China, Hubei Province in the central region, and Zhejiang Province in the east were chosen as the first-layer samples. Next, based on the stratified random sampling method, one or two cities from each province were chosen as second-layer samples. One subdistrict and one township from each city were chosen as third-layer samples. Then, a total of 28 communities, including 17 urban communities and 11 rural communities, were used as fourth-layer samples. Finally, a random sampling technique was employed to choose about 30 older

adults aged 60 years and above in each third-layer sample. The sample size was calculated using Scheaffer's sampling formula as

$$n = \frac{N}{(N-1)g^2} + 1 \quad (1)$$

Where n is the minimum sample size, N is the total population size for sampling, and g is the sampling error.

Based on data from the seventh national census, the sampling population consisted of home-dwelling adults aged 60 years and above in Shaanxi Province, Hubei Province, and Zhejiang Province, totaling 31,458,881 individuals. To reduce sampling error at the district, street, and community levels while considering survey costs, a sampling error of 3.5% was adopted, yielding a minimum required sample size of 817. From a statistical perspective, when the population size exceeds 500,000, the sample size should be no less than 800. For large-scale surveys, the sample size is required to be at least 1,000. Given that the population in this study is far larger than 500,000, the sampling design aimed to reduce sampling errors across all strata. One thousand older individuals in urban and rural areas were selected for interview-based questionnaires, resulting in 943 valid responses, with an effective rate of 94.3%. The sampling process and result are shown in Table 1.

Table 1
Variable definitions and coding assignments

Variable Name	Variable Coding
Perceptual bias	0 = No perceptual bias; 1 = Perceptual bias exists
Service utilization	0 = Never used the services; 1 = Have used the services
Age	Continuous value (actual age)
Self-rated health	1 = Very poor; 2 = Relatively poor; 3 = Fair; 4 = Relatively good; 5 = Very good
Marital status	1 = Married; 2 = Single; 3 = Divorced; 4 = Widowed
Living arrangement	1 = Living alone; 2 = Living with spouse; 3 = Living with children; 4 = Others
Number of children	Continuous value (actual count)
Pre-retirement occupation	1 = Civil servant; 2 = Staff of public institutions & enterprises; 3 = Self-employed; 4 = Farmer; 5 = Migrant worker; 6 = Others
Annual household income	Natural logarithm transformation
Province of residence	1 = Shaanxi; 2 = Hubei; 3 = Zhejiang
Community type	0 = Rural community; 1 = Urban community
Familiarity with the community	1 = Very unfamiliar; 2 = Slightly unfamiliar; 3 = Moderate; 4 = Relatively familiar; 5 = Very familiar
Attention to community-based services	1 = Never pay attention; 2 = Seldom pay attention; 3 = Moderate attention; 4 = Relatively attentive; 5 = Very attentive
Distance to service facilities	1 = More than 20 minutes by car; 2 = 10–20 minutes by car; 3 = Within 10 minutes by car; 4 = 5–15 minutes on foot; 5 = Within 5 minutes on foot
Gender	0 = Male; 1 = Female
Hukou	0 = Rural; 1 = Urban

To ensure the questionnaire was accurately understood, the research team was introduced into older adults' homes by community workers, and an interview-based approach was used, with one investigator explaining the questions to the older adults while another recorded their answers. A bar of soap and a towel were given to each participant after the questionnaire was completed.

The questionnaire was provided by Professor Zhang Sifeng and his research team at the School of Public Policy and Administration, Xi'an Jiaotong University. Its design adhered to the principles of rationality, precision, logic, non-induction, and understandability. Data collection was approved by the Ethics Committee of Xi'an Jiaotong University. Each participant was informed about the purpose of the survey, participated voluntarily, and was assured that their privacy would be strictly protected.

2.3 Measurement

2.3.1 Service Supply

HCBS can be divided into four categories: medical and health services, family substitution services, disability care services, and personal assistance services. The supply indicator for Category K HCBS in Community C is defined as Eq. (2):

$$S_K^C = \begin{cases} 0, \forall j, S_j^C = 0 \\ 1, \exists j, S_j^C = 1 \end{cases} \quad (2)$$

where S_K^C denotes the supply of Category K HCBS in Community C , and S_j^C represents the supply of the j -th specific service item within Category K . A value of 1 is assigned to S_K^C if the community provides any single item under Category K .

2.3.2 Perceptual Bias

For older adult A , their perception of service provision is defined in Eq. (3):

$$P_K^A = \begin{cases} 0, \forall t, P_t^A = 0 \\ 1, \exists t, P_t^A = 1 \end{cases} \quad (3)$$

Where P_K^A denotes older adult A 's overall perception of Category K , and P_j^A represents older adult A 's perception of the j -th individual item. An older adult is regarded as perceiving the provision of Category K services if they believe the community offers at least one of the j subordinate service items. The perceptual bias B_K^A of older adult A toward Category K is identified by evaluating the consistency between objective supply status S_K^C and subjective perception P_K^A , as specified in Eq. (4):

$$B_K^A = \begin{cases} 0, S_K^C = P_K^A \\ 1, S_K^C \neq P_K^A \end{cases}, \forall A \in C, S_K^C = 1 \quad (4)$$

For Community C with actual provision of Category K ($S_K^C = 1$), older adult A exhibits no perceptual bias toward Category K if they acknowledge the availability of such services. By contrast, perceptual bias emerges when the older adult believes the community does not provide Category K services.

2.3.3 Service Utilization

For Community C with Category K provision, an older adult A within the community is identified to have Category K service utilization if the adult has used at least one of the j specific service items under Category K over the past year. The binary utilization indicator U_K^A is defined in Eq. (5):

$$U_K^A = \begin{cases} 0, \forall j, U_j^A = 0 \vee S_K^C = 0 \\ 1, \exists j, U_j^A = 1 \wedge S_K^C = 1 \end{cases} \quad (5)$$

2.3.4 Independent and Control Variables

The older adult is the information receiver of HCBS, and their demand is influenced by physical function, family care resources, and socioeconomic resources [15]. Physical function is measured by older adults' age and self-rated health. Family care resources are captured by marital status, living arrangement, and number of children. Socioeconomic resources are measured by pre-retirement occupation and annual household income. The natural logarithm of annual household income is taken to eliminate dimensional effects.

Beyond individual heterogeneity, the formation of perceptual bias is also shaped by information sources and channels [16]. Existing studies have confirmed substantial disparities in the development of care services across regions and between urban and rural areas [7]. In addition, distance to the facility and older adults' information acquisition status also affect service accessibility [8, 13]. Thus, this study includes two independent variables—the province and community type—to characterize differences in information sources. Physical distance is proxied by the distance between respondents' living places and nearby HCBS facilities, while informational distance is represented by older adults' familiarity with and degree of attention to their communities. The aforementioned three indicators (familiarity, attention, and distance) are converted into continuous variables based on Likert-scale responses.

Existing studies have documented attitudinal disparities in HCBS utilization between urban and rural older adults [7], as well as heterogeneous demand for care services across genders [10]. Accordingly, gender and hukou (household registration status) are included as control variables. Variable definitions and coding assignments are presented in Table 1.

2.4 Statistical methods

Stata 15.1 (StataCorp, College Station, TX, USA) was used in data analysis. First, descriptive frequency distributions were used to report the current situation of underutilization and perceptual bias of HCBS. Second, a binary logistic regression model is utilized to test whether perceptual bias affects older adults' utilization behaviors. Third, the Heckman model is applied to separately explore the determinants of

perceptual bias formation for each type of service, and further examines the impacts of individual, household, and social factors on the uptake of HCBS after accounting for selection bias arising.

1. Logistic Regression

Let P denote the probability that an older adult engages in HCBS utilization behavior, and its log odds are defined in Eq. (6):

$$odds = \ln \left(\frac{P}{1-P} \right) \quad (6)$$

The logistic transformation yields the logit function as shown in Eq. (7):

$logit(P) = \ln \left(\frac{P}{1-P} \right)$ (7) Then, a Logistic regression model is constructed to examine older adults' HCBS utilization. In this model, y_i indicates whether older adult i uses HCBS; x_i represents the i -th independent variable; β_0 is the intercept term; β_i denotes the partial regression coefficient of the i -th independent variable, reflecting the magnitude of its effect on P . The corresponding probability formula is specified as:

$$P(y = 1|x_i) = \frac{e^{\beta_0 + \sum_{i=1}^n \beta_i x_i}}{1 + e^{\beta_0 + \sum_{i=1}^n \beta_i x_i}} \quad (8)$$

Maximum likelihood estimation is adopted in Eq. (8) to estimate the regression coefficient of each independent variable, and the z-test is employed to test the statistical significance of each predictor's effect on the dependent variable.

2. Heckman Model

z_i denotes the actual service supply received by the older adult; z_i^* is an unobservable latent variable; w_i represents the i -th independent variable; γ is the parameter to be estimated; and ϵ is the error term. Thus:

$$z_i^* = \gamma w_i + \epsilon \quad (9)$$

$$z_i = \begin{cases} 1, & z_i^* \leq 0 \\ 0, & z_i^* > 0 \end{cases} \quad (10)$$

According to the formula for the expectation of a truncated variable, ρ is the correlation coefficient, and λ is the inverse Mills ratio. The conditional expectation of the observed sample is:

$$E(p_i | z_i^* > 0) = \beta x_i + \rho \sigma_\epsilon \lambda \quad (11)$$

$$\lambda = \frac{\phi(-\gamma w_i)}{1 - \Phi(-\gamma w_i)} \quad (12)$$

Here, Φ is the cumulative distribution function of the standard normal distribution, and ϕ is the corresponding probability density function.

Substituting Eq. (12) into Eq. (8) yields the new equation that corrects for selection bias:

$$P(y_i = 1|x_i) = \frac{e^{\beta_0 + \sum_{i=1}^I \beta_i x_i + \rho \sigma \epsilon \lambda}}{1 + e^{\beta_0 + \sum_{i=1}^I \beta_i x_i + \rho \sigma \epsilon \lambda}} \quad (13)$$

Equation (13) is used to test the inverse Mills ratio λ . If λ is significant, selection bias exists; if λ is not significant, no selection bias exists [17].

In the second stage, the inverse Mills ratio is incorporated into the Logistic regression model to construct the outcome equation for older adults' service utilization after controlling for perceptual bias.

3. Results

3.1 Descriptive statistics

Descriptive statistics for the sample are presented in Table 2. The average age of surveyed older adults is 70.72 years (SD 7.32), and the sex ratio (with females set as 100) stands at 78.18, which is broadly consistent with the demographic structure reported in the Seventh National Population Census. The mean score of self-rated health is 3.88, indicating that most older adults perceive their physical health as “very good” or “relatively good”.

Table 2
Descriptive Statistics of Variables (N = 943)

Variable Name	Frequency (%)	Mean (SD)
Age		70.72(7.32)
Self-rated Health		3.88(0.41)
Marital Status		
Married	691(74.14%)	
Single	11(1.18%)	
Divorced	11(1.18%)	
Widowed	219(23.5%)	
Living Arrangement		
Living Alone	141(15.02%)	
With Spouse Only	549(58.47%)	
With Children/Family	223(23.75%)	
Other	26(2.77%)	
Number of Children		2.44(1.3)
Pre-retirement Occupation		
Civil Servant	54(5.73%)	
Public Institution/Enterprise Staff	336(35.63%)	
Self-employed	42(4.45%)	
Farmer	405(42.95%)	
Migrant Worker	48(5.09%)	
Other	58(6.15%)	
Annual Household Income		44265.35(96333.28)
Gender		
Female	527(56.12%)	
Male	412(43.88%)	
Hukou		
Rural	474(50.27%)	
Urban	469(49.73%)	

Variable Name	Frequency (%)	Mean (SD)
Community Type		
Rural Community	401(42.52%)	
Urban Community	542(57.48%)	
Familiarity with Community		3.68(1.49)
Attention to Community Care		3.41(1.24)
Distance to Service Facilities		3.87(1.35)

Older adults with rural household registration account for 50.27% of the total sample, while only 42.52% actually reside in rural communities. Spousal cohabitation applies to 74.14% of respondents, and widowhood accounts for 90.87% of all single older adults. A total of 82.22% of older adults live with their spouses or children. Most urban older adults were employed by enterprises or public institutions before retirement, whereas rural older adults were predominantly engaged in farming prior to age 60. Around 6.15% of respondents are categorized into the “other” group, as they held no formal jobs or worked as full-time housewives before turning 60. Income disparity is prominent among participants. The average annual household income of sampled older adults is 44,300 RMB, with a standard deviation of 96,300 RMB.

Service supply

Among the 28 communities surveyed (Table 3), personal assistance services are the most widely available, with every community providing this type of service and offering recreational and cultural facilities. Family-substitute services are provided by 26 communities, and healthcare services by 24 communities. Disability care services are the weakest in supply, offered by only 6 communities, of which just 2 provide professional services such as cleaning, nursing, and rehabilitation for older adults with disabilities.

Table 3
Number of Communities Supplying Each Home- and Community-Based Care Service
(Observations = 28)

Type	Communities	Item	Communities
Healthcare	24	Health Checkups	18
		Home Diagnostic Visits	17
		Health Guidance	11
		Chronic Disease Management	10
Family-substitute	26	Housekeeping Services	15
		Meal Services	20
		Safety/Security Services	18
		Household Facility Adaptation	10
Disability Care	6	Medication Assistance	6
		Daily Companionship Care	2
		Disability Nursing Care	2
		Assistive Devices	3
Personal Assistance	28	Recreational and Cultural Activities	28
		Emotional Companionship	24
		Errand/Shopping Assistance	18
		Psychological Counseling	15
		Lectures and Training	24

Service utilization and perception

Figure 2 illustrates the utilization and perception of the four types of HCBS. Perceptual bias is most severe for disability care services: 86.19% of surveyed older adults were unaware that their community supplied disability care services, and only 6.57% had ever used such services. For family-substitute services, 53.62% of older adults exhibited perceptual bias, while 19.19% had used them. For healthcare services, 32.04% exhibited perceptual bias, and 50.27% had used them. Personal assistance services showed the weakest perceptual bias, yet still 29.8% of older adults exhibited perceptual bias toward them, while 51.64% had used them.

3.2 Logistic regression results

This study used Stata 15.1 software to estimate the logistic models; the results are shown in Tables 4–5.

Table 4
Baseline Model Regression Results (Observations = 943)

Variable (Reference group in parentheses)	Model 1A Healthcare	Model 2A Family-substitute	Model 3A Disability Care	Model 4A Personal Assistance
Age	0.791** (-0.055)	1.181 (0.026)	0.816 (-0.019)	0.798** (-0.054)
Health Status	1.267*** (0.055)	0.985 (-0.002)	0.649** (-0.041)	1.21** (0.045)
Marital Status (Married)	-	-	-	-
Single	1.865 (0.14)	3.554* (0.253)	-	2.098 (0.169)
Divorced	1.173 (0.037)	3.583 (0.255)	5.147 (0.157)	3.756 (0.279)
Widowed	1.012 (0.003)	1.234 (0.033)	122.114*** (0.535)	1.443 (0.086)
Living Arrangement (Living Alone)	-	-	-	-
With Spouse Only	0.687 (-0.088)	1.079 (0.012)	3.38 (0.093)	1.194 (0.042)
With Children/Family	0.663 (-0.096)	0.776 (-0.037)	-	1.263 (0.056)
Other	0.121*** (-0.435)	0.425 (-0.104)	2.373 (0.061)	0.624 (-0.11)
Number of Children	1.276*** (0.057)	1.039 (0.006)	0.334* (-0.104)	0.916 (-0.021)
Pre-retirement Occupation (Civil Servant)	-	-	-	-
Public Institution/Enterprise Staff	1.19 (0.041)	1.037 (0.006)	0.816 (-0.024)	1.01 (0.002)
Self-employed	1.082	0.441	-	0.494

Variable (Reference group in parentheses)	Model 1A Healthcare	Model 2A Family-substitute	Model 3A Disability Care	Model 4A Personal Assistance
	(0.018)	(-0.112)		(-0.164)
Farmer	1.743 (0.129)	0.785 (-0.039)	0.074 (-0.194)	1.17 (0.037)
Migrant Worker	1.004 (0.001)	0.614 (-0.074)	-	0.782 (-0.058)
Other	1.066 (0.015)	0.287* (-0.15)	0.359 (-0.104)	0.952 (-0.012)
Log of Household Income	0.861 (-0.035)	1.028 (0.004)	1.234 (0.02)	1.182* (0.04)
Hukou (Rural)	-	-	-	-
Urban	1.938*** (0.151)	0.628* (-0.072)	1.995 (0.06)	0.879 (-0.03)
Gender (Female)	-	-	-	-
Male	1.1 (0.022)	0.793 (-0.036)	1.52 (0.038)	1.25 (0.053)
Constant	0.425	0.352*	0.124	0.982
Chi-square Statistic	51.586***	24.041	37.145***	43.311***
R ² Value	0.051	0.029	0.351	0.036

Table 5
Regression Results After Introducing Perceptual Bias (Observations = 943)

Variable (Reference group in parentheses)	Model 1B Healthcare	Model 2B Family-substitute	Model 3B Disability Care	Model 4B Personal Assistance
Perceptual Bias	-	-	-	-
Present	0.016 ^{***} (-0.679)	0.005 ^{***} (-0.422)	0.001 (-0.255)	0.007 ^{***} (-0.705)
Age	0.782 ^{**} (-0.036)	1.304 [*] (0.029)	0.679 (-0.03)	0.722 ^{***} (-0.045)
Health Status	1.172 [*] (0.023)	0.95 (-0.006)	0.601 ^{**} (-0.039)	1.152 (0.02)
Marital Status (Married)	-	-	-	-
Single	0.84 (-0.026)	1.927 (0.075)	-	2.96 (0.125)
Divorced	0.69 (-0.057)	8.1 [*] (0.222)	3459.478 (0.613)	2.768 (0.119)
Widowed	1.176 (0.023)	1.471 (0.044)	1529.347 ^{**} (0.415)	1.201 (0.025)
Living Arrangement (Living Alone)	-	-	-	-
With Spouse Only	1.104 (0.014)	1.153 (0.016)	91.577 (0.16)	1.421 (0.05)
With Children/Family	0.86 (-0.023)	0.921 (-0.009)	-	1.237 (0.031)
Other	0.685 (-0.058)	1.146 (0.015)	8700.132 (0.611)	5.44 [*] (0.187)
Number of Children	1.183 [*] (0.024)	1.132 (0.014)	0.288 ^{**} (-0.095)	0.955 (-0.006)

Variable (Reference group in parentheses)	Model 1B Healthcare	Model 2B Family-substitute	Model 3B Disability Care	Model 4B Personal Assistance
Pre-retirement Occupation (Civil Servant)	-	-	-	-
Public Institution/Enterprise Staff	1.022 (0.003)	0.966 (-0.004)	0.357 (-0.101)	0.809 (-0.028)
Self-employed	1.256 (0.031)	1.775 (0.067)	-	0.418 (-0.128)
Farmer	0.942 (-0.009)	0.79 (-0.027)	0.002 (-0.317)	0.77 (-0.035)
Migrant Worker	0.609 (-0.076)	1.182 (0.019)	-	0.577 (-0.077)
Other	0.868 (-0.021)	0.289 (-0.12)	0.308 (-0.114)	1.241 (0.026)
Log of Household Income	0.897 (-0.016)	1.153 (0.016)	0.757 (-0.021)	1.025 (0.003)
Hukou (Rural)	-	-	-	-
Urban	1.118 (0.016)	1.249 (0.025)	0.464 (-0.061)	1.259 (0.032)
Gender (Female)	-	-	-	-
Male	1.131 (0.018)	0.903 (-0.011)	1.054 (0.004)	1.346 (0.041)
Constant	1.575	0.48	0.187	2.221
Chi-square Statistic	362.554 ^{***}	291.235 ^{***}	52.550 ^{***}	460.540 ^{***}
R ² Value	0.357	0.352	0.496	0.386

The baseline model regression results for the four service types are presented in Table 4. The regression models for healthcare, disability care, and personal assistance services all passed the significance test, whereas the model for family-substitute services failed the overall test, indicating a poor model fit for family-substitute service utilization. The values of R² for healthcare, family-substitute, and personal assistance services were all below 0.1, reflecting the limited explanatory power of the baseline models.

The regression results for the four service models after introducing perceptual bias are shown in Table 5, and all four models passed the significance test. Perceptual bias significantly affected service utilization in the regression models for healthcare, family-substitute, and personal assistance services; after introducing the perceptual bias variable, the R^2 values increased by 0.306, 0.323, and 0.350, respectively, indicating that perceptual bias substantially improved the models' explanatory power. After introducing perceptual bias, the living arrangement and hukou variables in Model 1B, the age, pre-retirement occupation, and hukou variables in Model 2B, and the health status and household income variables in Model 4B became non-significant. This suggests that these variables may influence the utilization of healthcare, family-substitute, and personal assistance services indirectly, through older adults' perceptions. Accordingly, in the subsequent Heckman models, older adults' age, health status, living arrangement, pre-retirement occupation, household income, and hukou were included as control variables in the selection equation for further analysis.

Perceptual bias was not significant in the regression model for disability care services, and the R^2 value increased by only 0.145, lower than in the other three models, indicating that the effect of perceptual bias on disability care service utilization is not statistically significant. Older adults' health status, spouse, and children are the primary factors affecting disability care service utilization.

3.3 Heckman model results

This study used Stata 15.1 software to estimate the Heckman models; the results are shown in Tables 6–7.

Table 6
First-Stage Heckman Model Regression Results (Observations = 943)

Variable (Reference group in parentheses)	Model 5A Healthcare	Model 6A Family-substitute	Model 7A Disability Care	Model 8A Personal Assistance
Province (Shaanxi)	-	-	-	-
Hubei	1.31 ^{***} (0.303)	0.831 ^{***} (0.26)	0.299 (0.025)	0.542 ^{***} (0.148)
Zhejiang	2.629 ^{***} (0.726)	0.984 ^{***} (0.311)	1.126 ^{**} (0.059)	-0.283 (-0.056)
Community Type (Rural)	-	-	-	-
Urban	-0.307 [*] (-0.054)	-0.281 ^{**} (-0.083)	-1.037 ^{**} (-0.058)	0.645 ^{***} (0.142)
Familiarity with Community	-0.129 [*] (-0.023)	-0.198 ^{***} (-0.058)	-0.04 (-0.003)	-0.146 ^{**} (-0.034)
Attention to Community Care	-0.15 ^{**} (-0.026)	-0.053 (-0.015)	-0.188 (-0.015)	-0.024 (-0.006)
Distance to Community Facilities	-0.15 ^{***} (-0.026)	-0.235 ^{***} (-0.069)	-0.218 [*] (-0.017)	-0.074 (-0.017)
Age	-0.073 (-0.013)	-0.1 (-0.03)	0.138 (0.011)	0.143 ^{**} (0.033)
Health Status	-0.009 (-0.002)	0.051 (0.015)	0.162 [*] (0.013)	0.047 (0.011)
Living Arrangement (Living Alone)	-	-	-	-
With Spouse Only	0.268 (0.044)	-0.124 (-0.037)	0.647 [*] (0.063)	0.419 ^{**} (0.096)
With Children/Family	0.266 (0.043)	-0.024 (-0.007)	-	-0.061 (-0.011)
Other	0.525	-	-1.171	0.308

Variable (Reference group in parentheses)	Model 5A Healthcare	Model 6A Family-substitute	Model 7A Disability Care	Model 8A Personal Assistance
	(0.095)		(-0.225)	(0.067)
Pre-retirement Occupation (Civil Servant)	-	-	-	-
Public Institution/Enterprise Staff	-0.167 (-0.039)	-0.082 (-0.023)	-0.56 (-0.033)	-0.175 (-0.042)
Self-employed	-0.488 (-0.105)	0.481 (0.151)	-	-0.341 (-0.076)
Farmer	-0.861*** (-0.165)	0.04 (0.012)	-0.277 (-0.013)	-0.118 (-0.029)
Migrant Worker	-0.994** (-0.182)	0.523 (0.165)	-0.783 (-0.054)	-0.434 (-0.093)
Other	-0.456 (-0.099)	-0.043 (-0.012)	-1.259* (-0.118)	0.295 (0.083)
Log of Household Income	-0.275*** (-0.048)	-0.103 (-0.03)	-0.74** (-0.059)	-0.231** (-0.054)
Hukou (Rural)	-	-	-	-
Urban	-0.473** (-0.082)	0.781*** (0.234)	-0.167 (-0.012)	0.199 (0.046)
Constant	0.629	0.928**	4.682***	-0.73*
Chi-square Statistic	149.813***	126.831***	56.001***	67.225***
R ² Value	0.272	0.163	0.298	0.113

Table 7
Second-Stage Heckman Model Regression Results (Observations = 943)

Variable (Reference group in parentheses)	Model 5B Healthcare	Model 6B Family-substitute	Model 7B Disability Care	Model 8B Personal Assistance
Age	0.909 (-0.021)	1.218 (0.043)	0.839 (-0.013)	0.708** (-0.055)
Health Status	1.104 (0.022)	0.967 (-0.007)	0.854 (-0.012)	1.056 (0.009)
Marital Status (Married)	-	-	-	-
Single	0.977 (-0.005)	2.205 (0.178)	-	1.659 (0.071)
Divorced	1.059 (0.012)	29.39** (0.577)	0.484 (-0.042)	1.77 (0.078)
Widowed	0.849 (-0.036)	1.625 (0.108)	1.183 (0.013)	0.862 (-0.024)
Living Arrangement (Living Alone)	-	-	-	-
With Spouse Only	0.766 (-0.057)	0.987 (-0.003)	0.575 (-0.04)	1.359 (0.052)
With Children/Family	0.892 (-0.024)	0.78 (-0.053)	1.126 (0.01)	1.47 (0.064)
Other	0.226 (-0.33)	3.426 (0.276)	5.848 (0.225)	-
Number of Children	1.152 (0.031)	1.178 (0.035)	0.543*** (-0.045)	0.916 (-0.014)
Pre-retirement Occupation (Civil Servant)	-	-	-	-
Public Institution/Enterprise Staff	1.213 (0.042)	1.14 (0.026)	4.503 (0.137)	1.517 (0.06)
Self-employed	1.261	2.347	-	0.513

Variable (Reference group in parentheses)	Model 5B Healthcare	Model 6B Family-substitute	Model 7B Disability Care	Model 8B Personal Assistance
	(0.05)	(0.182)		(-0.123)
Farmer	1.076 (0.016)	1.873 (0.131)	0.667 (-0.02)	0.776 (-0.043)
Migrant Worker	0.885 (-0.027)	2.949 (0.233)	0.722 (-0.016)	0.487 (-0.134)
Other	0.814 (-0.046)	0.298 (-0.18)	1.25 (0.014)	1.69 (0.074)
Log of Household Income	0.798* (-0.049)	1.347* (0.065)	0.87 (-0.01)	0.928 (-0.012)
Hukou (Rural)	-	-	-	-
Urban	0.997 (-0.001)	1.99* (0.15)	0.28** (-0.099)	0.86 (-0.024)
Gender (Female)	-	-	-	-
Male	1.245 (0.047)	0.859 (-0.033)	1.203 (0.014)	1.586* (0.072)
λ	2.419*** (0.192)	0.566*** (-0.124)	6.871*** (0.142)	2.307*** (0.134)
Constant	0.242**	0.616	0.01***	0.701
Chi-square Statistic	55.13***	36.298**	73.702***	44.507***
R ² Value	0.068	0.066	0.2	0.084

The estimation results of the first-stage selection equations for the four service types, shown in Table 6, examine the determinants of perceptual bias. Compared with older adults in rural communities, those living in urban communities are less likely to exhibit perceptual bias toward healthcare, family-substitute, and disability care services, but more likely to exhibit perceptual bias toward personal assistance services. Older adults who are more familiar with their community and live closer to community-based care facilities are less likely to exhibit perceptual bias. Older individuals are more likely to exhibit perceptual bias toward personal assistance services as age increases. Older adults in better health are

more likely to exhibit perceptual bias toward disability care services. Compared with older adults living alone, those living with a spouse are more likely to exhibit perceptual bias toward disability care and personal assistance services. Compared with retired civil servants, older farmers or migrant workers are more likely to exhibit perceptual bias toward healthcare services.

The estimation results of the second-stage outcome equations for the four service types, shown in Table 7, examine the effects of relevant factors on service utilization after controlling for the selection bias caused by perceptual bias. In all four logistic models, the inverse Mills ratio λ was statistically significant, indicating that whether older adults exhibit perceptual bias introduces selection bias into the analysis of factors influencing the utilization of all four service types.

Models 5B, 6B, 7B, and 8B respectively reflect the factors affecting older adults' utilization of healthcare, family-substitute, disability care, and personal assistance services after controlling for the selection bias caused by perceptual bias. In Model 5B, only the household income variable was statistically significant: older adults with higher household income were less likely to use healthcare services. Physical health status and family caregiving capacity mainly affect older adults' perception of healthcare services, while household income is the only factor with a direct effect on utilization. In Model 6B, marital status, household income, and hukou significantly affect family-substitute service utilization: divorced older adults, those with urban hukou, and those with higher household income are more likely to use family-substitute services. In Model 7B, the number of children and hukou are significant: older adults with fewer children and those with rural hukou are more likely to use disability care services. In Model 8B, age is the only significant independent variable: as age increases, older adults become less likely to use personal assistance services, while the remaining factors mainly act indirectly on utilization behavior through their effect on perception.

3.4 Explanations for the effect of perceptual bias on HCBS utilization

3.4.1 Rural older adults' use of healthcare services is constrained by perceptual bias

Existing research suggests that the utilization of healthcare services is mainly influenced by older adults' age, health status, income, and family support [3, 7]. This study further finds that individual physical condition, family caregiving capacity, and socioeconomic resources primarily determine older adults' perception of healthcare services. Among older adults who correctly perceive community service provision, only economic income status has a direct effect on their utilization behavior.

Healthcare services are typically provided by primary healthcare centers and include basic checkups, diagnosis, and health management, often at low cost or free of charge. Even when higher-income older adults are aware of such provision, they tend to prefer more expensive, higher-quality medical services. In particular, older adults who enjoy higher pension and medical insurance benefits are often less likely

to use healthcare services [4]. Consequently, the core group in need of healthcare services consists of older adults with lower income and weaker medical coverage who are more sensitive to service costs, such as those enrolled in the Urban and Rural Resident Basic Pension Insurance and the Urban and Rural Resident Basic Medical Insurance.

Existing research has found that retired enterprise employees are more likely to use healthcare services than rural older adults, despite the latter's lower average income and greater price sensitivity to healthcare services [3]. This phenomenon can be explained once perceptual bias is taken into account. Rural older adults tend to live in more dispersed settlements, face longer average distances to service facilities, and generally pay less attention to such services. Even when communities provide family doctor services, health management, and free checkups, ineffective information transmission means that older adults with the greatest need are, in practice, less likely to use healthcare services.

2.4.2 Family-substitute services diverted from target groups due to perceptual bias

Family-substitute services require relatively low professional skill, and their target population is older adults who face daily living difficulties and lack care from family members [18]. However, many related studies have found that family caregiving capacity has no significant effect on the utilization of family-substitute services [4]. This study finds that perceptual bias is the most significant factor influencing family-substitute service utilization. Whether older adults use family-substitute services depends more on their distance to home- and community-based care facilities and their familiarity with community service provision than on the intensity of their actual need.

Most current family-substitute services are treated as “universally inclusive services” without eligibility conditions [19], and are provided below market price through government subsidies. Older adults who live near home- and community-based care facilities and are more familiar with community services tend to benefit more from this arrangement. For example, subsidized meals offered at low prices by senior canteens are often taken up by older adults who do not actually lack family care resources. Meanwhile, older adults who genuinely lack care from their children and are in poor health are more prone to perceptual bias because of their weaker capacity to access information. Even when communities provide the family-substitute services they urgently need, information asymmetry prevents these older adults from utilizing them in time.

Field research reveals negative effects of this undifferentiated supply model. In some communities, government-subsidized steamed buns sold at extremely low prices in senior canteens are bought up by older adults outside the target population, leaving those with genuine need unable to secure regular meals and imposing an unnecessary burden on the operating institutions. Some communities have provided free emergency call bracelets to all older adults, but because no conditions were set on when the call/rescue function could be used, many older adults used the device frequently for trivial matters, at times overwhelming and paralyzing the response network. Meanwhile, many older adults living alone, finding cooking inconvenient, eat only plain rice porridge or noodles in clear broth for all three daily

meals; some with mobility difficulties need roughly half an hour to climb up and down stairs each time they buy groceries or take out the trash; and some older adults living alone who fall and are injured at home have no one to take them to the hospital because their children work far away. The family-substitute services provided by communities thus struggle to fulfill their intended function.

3.4.3 Perceptual bias exacerbates the shortage of disability care services

Disability care services exhibit the most severe perceptual bias among the four service types, with 86.19% of older adults unaware that their community supplies disability care services. Even among older adults who need disability care services, 80% exhibit perceptual bias. However, the logistic regression results show that perceptual bias alone has no significant effect on disability care service utilization; rather, health status and family caregiving capacity are the main factors affecting older adults' use of disability care services, consistent with findings from existing research [4].

The reason lies in the delayed nature of older adults' and their families' perception of disability care services. Although China has entered an aging society, disabled older adults still constitute a relatively small proportion of the older population at this stage, and most disabled older adults reside in institutional care settings [20]. For older adults living at home, the family is the primary caregiver once disability occurs. Only when an older adult becomes disabled and the family is unable to provide adequate care does the need arise to search for information on disability care services [15]. Consequently, the supply of disability care services is, most of the time, not accurately perceived by the majority of older adults. Once older adults fall into a state of disability, however, the rigidity of their need prompts them and their families to actively seek out available services, and the resulting information asymmetry is passively resolved within a short period.

Because disability care services require hiring professional staff and entail high supply costs, most urban community-based care service centers and rural mutual-aid happiness courtyards are unable to provide them. Primary healthcare institutions focus on public health and basic medical services and, lacking beds and professional nursing staff, generally do not provide disability care services. A small number of communities with embedded care institutions offer a limited number of disability care beds, with restricted coverage. After receiving a one-time government bed subsidy, some embedded care institutions lack the funds to sustain operations. Thus, demand for home- and community-based disability care services is small in volume but rigid in nature. Currently, on the one hand, disabled and semi-disabled older adults account for only 10.46% of home-dwelling older adults, so building asset-heavy, high-cost embedded care institutions may lead to underutilized resources; on the other hand, care and nursing services remain a rigid necessity for safeguarding the life safety and dignity of disabled older adults. The survey finds that nearly all disabled older adults living at home rely heavily on their spouses and children for care. As the wave of population aging deepens, the shortage of disability care service supply will inevitably leave home-dwelling disabled older adults without adequate care.

3.4.4 Rural communities concentrate on low-cost personal assistance services

Although perceptual bias toward personal assistance services is the weakest among the four service types, it still significantly affects older adults' utilization of these services. Many studies have found that rural older adults are more likely than urban older adults to use community recreational and cultural services [5, 8], which appears to contradict the fact that rural home- and community-based care service supply generally lags behind that of urban areas. This study finds that rural communities ex

hibit higher perceptual bias than urban communities for healthcare, family-substitute, and disability care services, but significantly lower perceptual bias for personal assistance services. Because rural home- and community-based care service provision tends to be limited to a single category, with most rural "happiness courtyards" offering only recreational and cultural facilities [21], rural older adults can more accurately grasp the recreational and cultural services available in their own village, while remaining less aware of other types of services.

Field research finds that, constrained by funding and capacity, most rural HCBS face supply difficulties. In interviews, township staff reported that current policy requires full coverage of rural "happiness courtyards," but because the government funding received cannot fully cover construction costs, resources from three villages often must be pooled to jointly build a single rural happiness courtyard. Because personal assistance services are relatively low-cost to supply and manage, most rural communities prioritize building this type of service. Some rural happiness courtyards' recreational and cultural offerings amount to little more than opening up an unused building as a chess/card room or a calligraphy and painting room; some villages regard designating a section of open space in front of the village committee building as providing an activity center for older adults; and some village staff regard their routine household visits to older residents as equivalent to providing regular visitation and emotional-support services [3]. Although this low-cost supply model meets some needs, it fails to address rural older adults' core care service needs.

4. Discussion

4.1 Main findings

Based on survey data from 28 communities across 8 cities in 3 provinces and 943 older adults, this study constructs a theoretical model of perceptual bias in HCBS and analyzes the effect of older adults' perceptual bias on the utilization of four types of HCBS—healthcare, family-substitute, disability care, and personal assistance services. The main findings are as follows:

First, older adults' perceptual bias toward HCBS significantly affects the utilization of all four service types, and introducing the perceptual bias variable plays a key role in explaining older adults' utilization behavior.

Second, the formation of home-dwelling older adults' perceptual bias is influenced by community type and location, as well as by older adults' age, health status, living arrangement, and pre-retirement occupation.

Third, factors related to individual physical condition, family caregiving capacity, and socioeconomic resources mainly affect older adults' utilization of services indirectly, by shaping their perception of HCBS.

Fourth, perceptual bias affects the utilization of HCBS by constraining rural older adults' use of healthcare services, causing family-substitute services to diverge from their target population, exacerbating the shortage of disability care service supply, and leading rural communities to concentrate on low-level personal assistance services—ultimately resulting in low resource utilization efficiency in HCBS.

4.2 Policy implications

4.2.1 Proactive outreach to provide basic services to disadvantaged older adults

In the traditional care system, safety-net protection for disadvantaged older adults—those living alone, in poor health, disabled, or in poverty—has relied on publicly run institutional care facilities. Amid China's rapidly growing older population, the trend toward advanced age and disability, and older adults' cultural preference for aging in place, HCBS have become an important supplement to institutional care and are increasingly the primary means of addressing older adults' difficulties [20]. The primary intended beneficiaries of HCBS should be home-dwelling older adults facing care hardship. However, constrained by limited access to information, disadvantaged older adults are more prone to perceptual bias, which prevents them from effectively utilizing the services communities provide. Given the realistic constraint of limited resources for developing HCBS, efforts to raise utilization rates should prioritize the actual needs of this group.

The routine household-visit responsibilities carried out by communities should be closely integrated with HCBS provision. Communities should proactively publicize their public-welfare care services to older adults who have lost their only child, live alone, or are left behind by migrant family members. The scope of service beneficiaries should be appropriately limited, using a screening mechanism to target limited resources toward older adults with insufficient family caregiving capacity. Once the needs of disadvantaged older adults are secured, the target population can gradually be expanded to all home-dwelling older adults, providing social welfare commensurate with the nation's level of economic development to guarantee basic needs [22]. The core function of this expansion is not to comprehensively meet older adults' diverse, individualized needs, but to uniformly provide basic service guarantees with the character of a public good, thereby reducing the likelihood that older adults fall into hardship and improving their overall quality of life. In regions with a surplus of resources, services can be

provided, following market principles, at a reasonable price to families with ample caregiving capacity, in order to ease the caregiving burden on their adult children.

4.2.2 Strengthening the availability of disability care services

As China's population aging advances toward more advanced age and higher disability rates, the rigid demand for care among disabled and semi-disabled older adults is growing rapidly. As the foundation and mainstay of China's care service system, HCBS will need to assume a greater role in disability care. However, constrained by limited community supply capacity, the shortage of disability care services, compounded by information asymmetry and perceptual bias, prevents high-need disabled older adults from obtaining necessary services in a timely manner.

To raise the utilization rate of HCBS, more resources should be devoted to ensuring the supply of care and nursing services for home-dwelling, health-vulnerable older adults who are disabled or semi-disabled. A multi-tiered system of disability care service provision should be developed based on home-dwelling older adults' self-care ability and their families' caregiving capacity. Long-term care services should be provided for semi-disabled or ill older adults with some remaining self-care ability, and short-term care services for older adults temporarily bedridden due to illness, in order to guarantee older adults' basic living and survival needs. For older adults who are fully bedridden and have completely lost self-care ability, resource allocation should be strengthened, engaging professional nursing staff at higher pay to provide formal medical and nursing support to disabled older adults and their families.

4.2.3 Improving the quality of rural HCBS

Rural HCBS currently remain trapped in a low-quality equilibrium. The services most widely perceived by rural older adults are personal assistance services such as recreational and cultural activities, which are low-cost to build and operate but have limited effect on improving older adults' health and quality of life. Healthcare services such as regular checkups and health management, as well as services targeting disadvantaged older adults who are disabled or living alone, suffer from low service quality that leaves older adults with little awareness of them, resulting in ineffective supply in rural communities. This, in turn, creates a perverse incentive for more rural communities to invest resources in low-quality service construction simply to meet policy requirements for HCBS coverage, forming a vicious cycle.

The development of rural HCBS should not rely on a "one-size-fits-all" administrative approach that forces rural communities into widespread low-quality construction. Limited resources should instead be concentrated on prioritizing healthcare provision for rural older adults, in order to narrow the urban–rural gap in the process of healthy aging. In particular, township-level primary healthcare institutions should progressively expand their provision of home-visit medical services, thereby reducing the perceptual bias in service awareness caused by differences in distance.

As for personal assistance services that meet home-dwelling older adults' needs for education, continued contribution, lifelong learning, and recreation in later life, these should not be treated as basic

care services that consume excessive public resources while rural home-dwelling older adults' basic health and living needs remain inadequately guaranteed.

4.2.4 Limitations

This study has several limitations. First, the cross-sectional design precludes causal inference; longitudinal data would better capture the dynamic relationship between perception and utilization. Second, perceptual bias was measured as a binary indicator based on consistency between objective supply and subjective awareness; more nuanced continuous or multi-item measures could capture degrees of awareness. Third, although the sample covers three provinces representing eastern, central, and western China, generalizability to other regions or national-level populations should be made with caution. Fourth, community-level supply was measured at the presence level rather than intensity or quality, which may understate variation in service provision.

5. Conclusions

Perceptual bias is a significant barrier to the effective utilization of home- and community-based services among older adults in China. It operates through information source, channel, and receiver mechanisms and introduces selection bias into conventional analyses of service utilization. Addressing perceptual bias through proactive outreach, improved disability care accessibility, and higher-quality rural service provision is essential for improving the efficiency of HCBS resource allocation and supporting aging in place.

Abbreviations

HCBS
Home- and community-based services
OR
Odds ratio
SD
Standard deviation

Declarations

Ethics approval and consent to participate

All methods in the study were conducted in accordance with the Declaration of Helsinki and relevant guidelines, and approved by the Medical Ethics Committee of the Health Science Center of Xi'an Jiaotong University (protocol code 2018–1200). The informed consent form was obtained from all subjects involved in the study. Each subject's participation was voluntary, and their privacy would be strictly protected.

Clinical trial number

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Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

H.Z. conceived and designed the study, analyzed the data, and wrote the manuscript. The author read and approved the final manuscript.

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Data Availability

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

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Figures

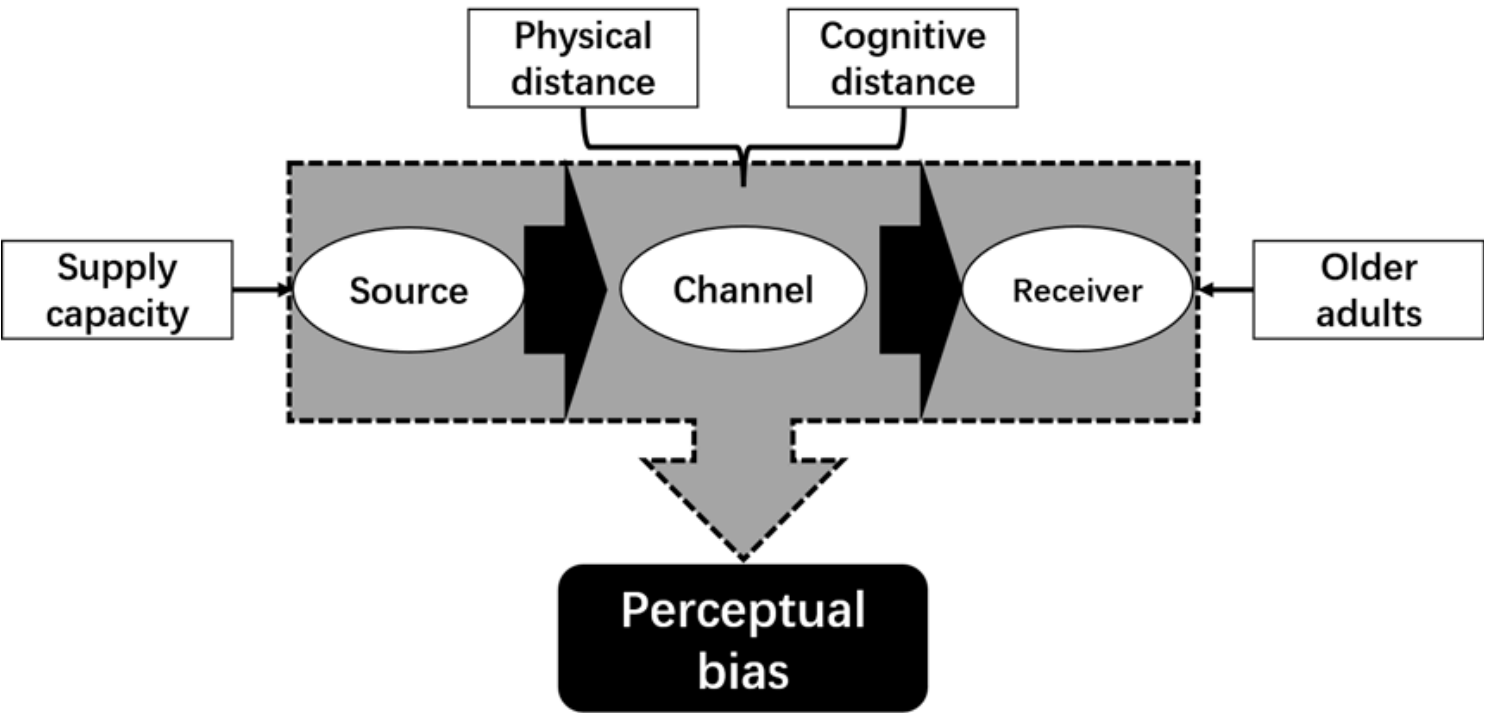


Figure 1

Formation Pathway of Perceptual Bias in HCBS

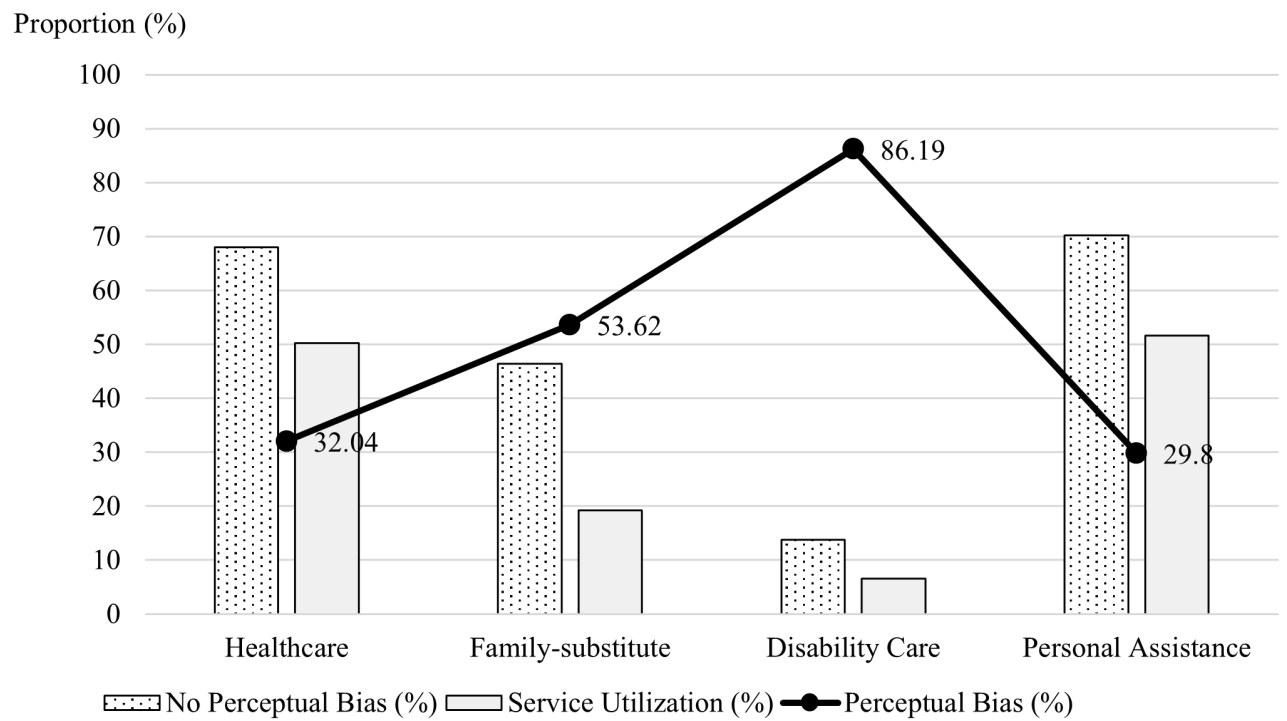


Figure 2

Utilization and Perception of HCBS

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1.docx](#)
- [Table3.docx](#)
- [Table7.docx](#)
- [Table6.docx](#)
- [Table2.docx](#)
- [Table4.docx](#)
- [Table5.docx](#)
- [QuestionnaireEN.docx](#)