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How economic development affects healthcare access for people with disabilities: A multilevel study in China

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ABSTRACT

Meeting the healthcare needs of people with disabilities is an important challenge in achieving the central promise of "leave no one behind" during the Sustainable Development Goals era. In this study, we describe the accessibility of healthcare for people living with disabilities, as well as the potential influences of individuals' socioeconomic status and regional economic development. Our data covered 324 prefectural cities in China in 2019 and captured the access to healthcare services for people with disabilities. First, we used linear probability regression models to investigate the association between individual socioeconomic status, including residence, poverty status, education, and healthcare access. Second, we conducted an ecological analysis to test the association between prefectural economic indicators, including GDP (gross domestic product) per capita, urbanization ratio, average years of education, Engel's coefficient, and the overall prevalence of access to healthcare for people with disabilities within prefectures. Third, we used multilevel regression models to explore the association between the individual's socio-economic status, prefectural economic indicators, and access to healthcare at the individual level for people with disabilities. The results showed, first, that higher individual socioeconomic status (urban residence or higher educational level) was associated with better access to healthcare for people with disabilities. Second, regional economic indicators were positively associated with access to healthcare at the aggregate and individual levels. This study suggests that local governments, particularly in low- and middle-income countries, should promote economic development and conduct poverty alleviation policies to improve healthcare access for disadvantaged groups.

1. Introduction

Globally, over one billion people live with disabilities. People with disabilities have poorer health and disadvantaged living opportunities than people without disabilities, primarily due to their lack of access to social services, including healthcare, as the 2011 World Report on Disability and the 2022 Global Report on Health Equity for Persons with Disabilities pointed out (World Health Organization, 2011, 2022). Without promoting healthcare for people with disabilities, the United Nation's Sustainable Development Goal 3 (SDG 3) to "ensure healthy lives and promote well-being for all at all ages" and the World Health Organization's Universal Health Care (UHC) goals cannot be met (Bright & Kuper, 2018; Kuper & Heydt, 2019).

In the last several decades, China has experienced significant economic growth, with its per capita GDP (gross domestic product) increased from 430 US dollars (constant 2015 USD) in 1980 to 10,358 US dollars (constant 2015 USD) in 2020. Despite this economic growth, there are still deficiencies in healthcare accessibility across China. This disproportionately impacts people with disabilities, who have unique challenges in accessing healthcare (Bright & Kuper, 2018; Chan et al., 2022). For example, evidence shows that people with disabilities are more likely to live in areas with fewer health services, live in poverty, and have less access to education (Guo et al., 2015; Lei et al., 2016; Loyalka et al., 2014). Barriers to physical activity, communication, and

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stereotypes make it more difficult for individuals with disabilities to access healthcare (Pearce et al., 2022; Sowney & Barr, 2004). Moreover, prior studies have found that factors such as income, health insurance, and education can influence healthcare accessibility for people with disabilities (Adugna et al., 2020; Alborz et al., 2005; Mirza et al., 2014) and disparities in accessing healthcare between people with and without disabilities (da Cunha et al., 2022; Jumreornvong et al., 2020). However, few studies have explored the leading factors of disparities in accessing healthcare among people with disabilities (Chen et al., 2020).

For the whole population, prior studies have shown that macro-level economic factors, such as per capita GDP and urbanization levels, are related to the prevalence of healthcare access, since local governments with better economic conditions will have more monetary resources to put into health sectors (Li et al., 2020; Wang et al., 2018). For example, a study in China showed that regional economic indicators (such as per capita GDP) were positively associated with the overall accessibility of primary healthcare services (Wang et al., 2018). Furthermore, provincial-level per capita GDP is related to inpatient and outpatient care utilization for elderly people in China (Li et al., 2020). However, the relationship between regional economic development and healthcare access among individuals with disabilities is still unclear and needs investigation.

The Chinese government has attempted to provide accessible healthcare to people with disabilities nationally; for example, it issued the country's first specific health and rehabilitation policy for people with disabilities in 2017 (Zhao & Zhang, 2018). Central and local governments have also aided by providing health and therapy services for families of children with disabilities (Fisher & Shang, 2013), but significant gaps in access to care remain. Moreover, there is substantial heterogeneity in access to healthcare among people with disabilities. Most existing studies on inequalities in healthcare access for people with disabilities in China have focused on individual-level factors, with a few focusing on the effect of regional economic backgrounds. At the individual level, for example, it was revealed that elderly people with disabilities are likelier to have worse social security benefits and less access to long-term care than others (Lei et al., 2016). Another study found that elderly people with disabilities with rural residences had worse access to caring services than those with urban residences (Chen et al., 2014). At the regional level, few studies have investigated the effects of subnational-level economic backgrounds. For instance, one study found that Chinese elderly with disabilities in non-eastern areas had less healthcare utilization than those in eastern areas (Guo et al., 2015), while another revealed regional disparities in rehabilitation resources for people with disabilities across China's western, central, and eastern regions (Jing et al., 2020). However, these subnational studies overlook the impact of heterogeneous economic indicators within provinces at the prefectural or county levels (Boing et al., 2020; Sun et al., 2013; Xu et al., 2019).

Considering the limitations of these studies (Boing et al., 2020; Sun et al., 2013; Xu et al., 2019), this study adopted multilevel models, an effective method for analyzing the effect of influencing factors on healthcare access at the individual and regional levels simultaneously (Boing et al., 2020; Hasan et al., 2020; Jung et al., 2019; Or & Penneau, 2018; Rathmann et al., 2016; Richter et al., 2012; Subramanian et al., 2001; Subramanian et al., 2006; Surendra et al., 2022), to explore the association between individual socio-economic status, regional economic indicators, and healthcare access for people with disabilities in China based on a nationally representative survey dataset. Individual socioeconomic status included residence, poverty status, and education; regional economic indicators included per capita GDP, urbanization ratio, average years of education, and Engel's coefficient. We used linear probability regression models to investigate the association between individual socioeconomic status and access to healthcare; an ecological analysis to test the association between prefectural economic indicators and the overall prevalence of access to healthcare for people with disabilities within prefectures; and multilevel regression models to explore the association between socio-economic status, prefectural economic indicators, and access to healthcare at the individual level.

2. Methods

2.1. Data source

The data used in this study were drawn from a nationwide census on people with disabilities, covering more than 30 million respondents from 31 provinces across the Chinese mainland. The survey system included people with a disability certificate. For example, to obtain the official disability certificate, a person with disability need to hold their resident identity cards and apply for the Disabled Persons' Certificate at the county-level Disabled Persons' Federation based on their household registration. A mandatory disability assessment is conducted at designated assessment institutions within a specific timeframe. Approval of the application is contingent upon meeting the established disability standards and relevant regulations. If the applicant's assessment results do not align with the disability standards will not be granted the certificate. A disability certificate indicates one's disability status and is the basis for receiving corresponding social assistance. In China, every person with one or multiple classified disabilities can apply for a disability certificate. The survey collected information on respondents' demographic characteristics, disability levels and types, socioeconomic status, and healthcare access, etc.

2.2. Study population and sample size

We initially extracted a sub-sample of 22,991,951 individuals from the survey's 2019 cross-section. The sample included adults with disabilities aged 18 to 65 from 31 provinces and 324 prefecture-level cities (leagues and prefectures) in the Chinese mainland. We excluded 270,473 individuals missing poverty status records and 439,125 missing prefectural location records and merged them with prefectural level data. Then, we excluded 692,365 individuals without valid average years of education records and 176,150 without valid Engel coefficient records at the prefectural level. Regarding the dependent variable of access to healthcare, we excluded 20,635,270 individuals who were missing healthcare access records or had not been ill in the two weeks preceding the survey, and had thus not been asked the corresponding questions. Finally, we obtained a valid dataset with a sample size of 778,568 (see Fig. 1).

2.3. Dependent variable

In this study, healthcare access is measured by whether an individual accesses healthcare services when ill. The survey asked respondents if they had been ill in the past two weeks. Those who answered "No"' were excluded; those who answered "Yes" were asked if they had received healthcare services while ill. Respondents were instructed to reply "Yes" if they had received healthcare services (visited a health facility or obtained treatment from other sources) during their illness and "No" if they had not.

2.4. Independent variables

At the individual level, based on insights from prior studies (Guo et al., 2015; Lei et al., 2016; Loyalka et al., 2014; Paccoud et al., 2020; Pulok et al., 2020), we included independent variables related to respondents' socioeconomic status. These variables included residence (rural or urban), poverty status (p or not), and education (illiterate, primary school, middle school, senior school, or college and above). The individual's poverty status was identified by local governments. The poverty identification standards generally include if the individual had enough food, wearing, compulsory education (9-year), basic healthcare insurance, and secured housing. The standards differed across rural and

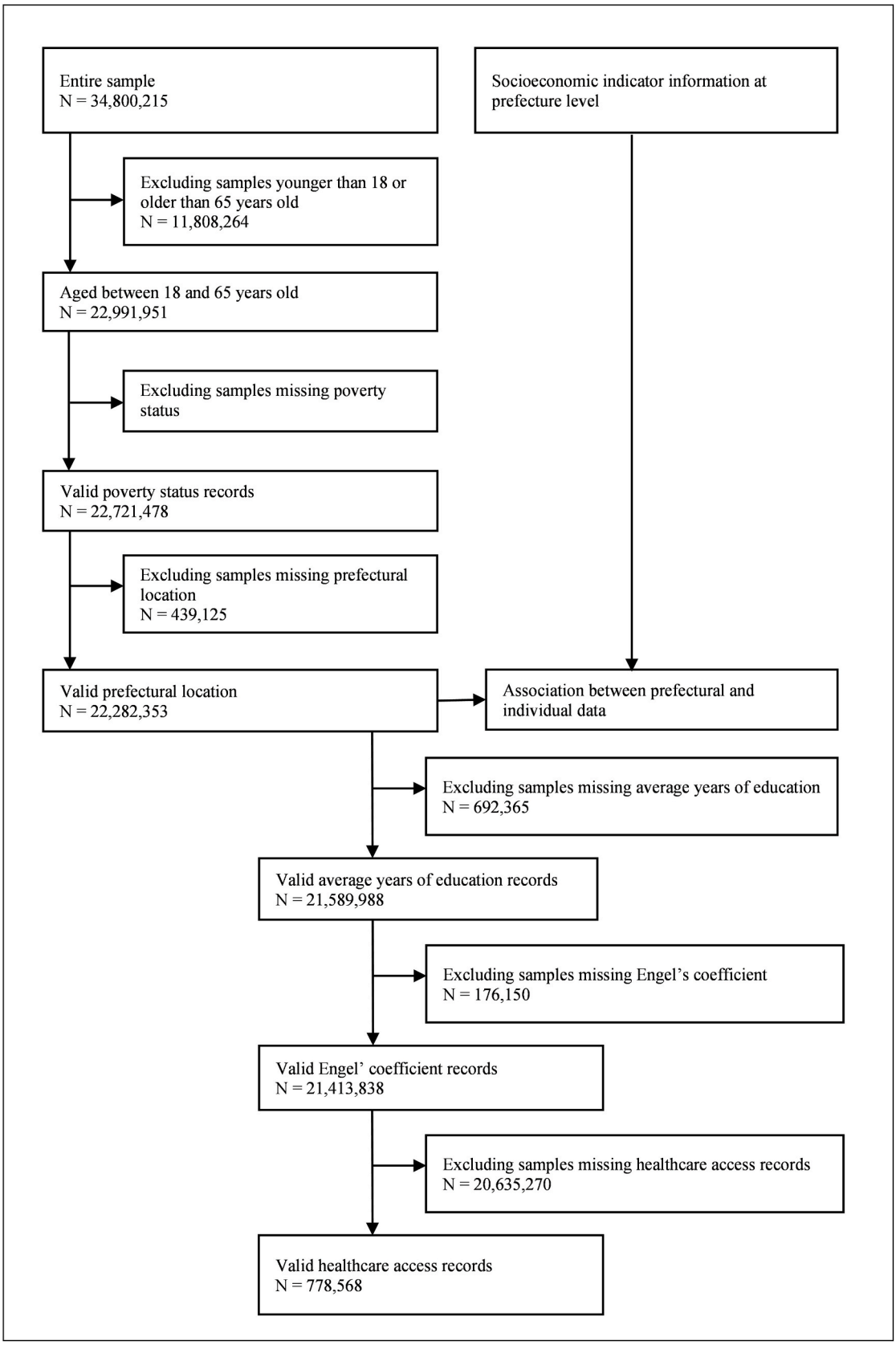

Fig. 1. Flow chart of data.

urban areas, and different prefectures across the country according to local economic development levels.

At the prefectural level, we included four economic indicators—per capita GDP, urbanization ratio, average years of education, and Engel's coefficient. Per capita GDP is a commonly used indicator of national and regional economic development when discussing health inequalities (Li & Wei, 2014); our models used the common logarithm of per capita GDP at the prefecture level. The urbanization ratio also shows regional economic development levels, especially in low- and middle-income countries like China (Chen et al., 2014); average years of education demonstrate regional human capital levels, which are associated with economic development (Barro, 2001). Engel's coefficient is also frequently used to indicate regional economic development and living standards at the macro level (Xie et al., 2022). Data for these indicators were collected from the statistical yearbooks of national and local statistics bureaus in China. In this study, individual data was merged with data on per capita GDP, urbanization ratio, average years of education, and Engel's coefficient for the same prefectural city in 2019; individuals from the same prefectural city were assigned the same four economic development indicators. In the dataset used, survey data for healthcare access at the individual level were combined with economic indicators at the prefectural level.

2.5. Covariables at the individual level

The study included a set of covariates at the individual level, such as respondents' demographic characteristics and disability type and level (Guo et al., 2015), that may affect accessing healthcare for people with disabilities at the individual level. These covariates included sex (male/female, as assigned at birth), age (common logarithm of years), marital status (in marriage/not in marriage), and employment (employed/unemployed). Based on findings from a prior study (Loyalka, 2014), we also included respondents' disability level (mild/severe) as identified in the disability certificate, disability type (physical/mental and intellectual/visual, hearing, and speech/multiple), and whether they had medical insurance.

2.6. Statistical analysis

Before statistical modeling, a descriptive analysis was conducted using the above variables. For healthcare access for people with disabilities, the prevalence level and confidence intervals at the 95% level were reported. For other nominal variables, n and percentage were reported; for continuous variables, mean value and standard deviation (SD) were reported.

There were three steps in the statistical analysis:

Step 1:

We used linear probability regression models to investigate the association between individual socioeconomic status, including residence, poverty status, education, and healthcare access. We conducted three univariate regression models, and multivariate regression models without control variables, and with control variables.

The linear probability regression models can be represented by:

$$Y = \beta_0 + \beta_1 SES + \beta_2 Sex + \beta_3 Age + \beta_4 Marriage + \beta_5 Insurance + \beta_6 Employment + \beta_7 Level + \beta_8 Type + \varepsilon$$

In these models, Y is healthcare access; SES is the individual's residence, poverty status, or education; and ε is the error term.

Step 2:

We conducted an ecological analysis to test the association between prefectural economic indicators, including per capita GDP, urbanization ratio, average years of education, Engel's coefficient, and the overall prevalence of access to healthcare for people with disabilities within prefectures. Firstly, we calculated the prevalence of healthcare access for each prefecture over different groups of respondents in residence, poverty status, and education. We then divided prefectures covered in this study into four quarter groups (group 1 for the first quarter, group 4 for the last quarter) over economic indicators, including per capita GDP (log), urbanization ratio, average years of education, and Engel's coefficient. Finally, we drew box charts to demonstrate the association between healthcare access prevalence and the groups of economic indicators at the prefectural level.

Step 3:

We used multilevel regression models to explore the association between the individual's socioeconomic status, prefectural economic indicators, and access to healthcare at the individual level for people with disabilities. We conducted four models to test the association between four economic indicators and access to healthcare at the individual level, adjusting for variables at the individual level. All models included fixed effects for prefectural economic indicators and random effects.

The multilevel regression models can be represented by:

Layer 1:

$$Y_{ij} = \beta_{0j} + \beta_{1j} SES_{ij} + \beta_{2j} Sex_{ij} + \beta_{3j} Age_{ij} + \beta_{4j} Marriage_{ij} + \beta_{5j} Insurance_{ij} + \beta_{6j} Employment_{ij} + \beta_{7j} Level_{ij} + \beta_{8j} Type_{ij} + \varepsilon_{ij}$$

Layer 2:

$$\beta_{0j} = \alpha_0 + \lambda_1 ECO + \mu_{0j}$$

$$\beta_{1j} = \alpha_1 + \mu_{1j}$$

$$\beta_{2j} = \alpha_2 + \mu_{2j}$$

$$\beta_{3j} = \alpha_3 + \mu_{3j}$$

$$\beta_{4j} = \alpha_4 + \mu_{4j}$$

$$\beta_{5j} = \alpha_4 + \mu_{5j}$$

$$\beta_{6j} = \alpha_6 + \mu_{6j}$$

$$\beta_{7j} = \alpha_7 + \mu_{7j}$$

$$\beta_{8j} = \alpha_8 + \mu_{8j}$$

In these models, i denotes the individuals, j denotes the prefectures, and Y is healthcare access; SES is the individual's residence, poverty status, or education; ECO is the prefectural indicator of economic development (i.e., per capita GDP, urbanization ratio, average years of education, or Engel's coefficient); and ε is the error term.

We used Stata (version 17.0) for modeling and ggplot2 on R (version 4.2.1) for data visualization. All statistical tests were two-sided; $p < 0.05$ was set as the statistical significance level.

3. Results

3.1. Descriptive results

Overall, 778,568 respondents with disabilities aged 18–65 years old (in 2019) were included in the study. The final dataset included 324

prefectural cities in the Chinese mainland with complete economic indicators of per capita GDP, urbanization ratio, average years of education, and Engel's coefficient at prefectural level.

Descriptive statistics of the respondents are presented in Table 1. The average age of respondents was 51.40 years old, with 42.72% being female and 57.28% being male. Approximately 35.42% of the respondents lived in urban areas, 64.58% lived in rural areas, 38.45% were in poverty, and 61.55% were not in poverty. Concerning education attainment, 13.35% of the respondents were illiterate, 28.68% completed primary school, 38.75% completed senior school, 15.03% completed senior school, and 4.19% completed college or above. For prefecture-level variables, the average per capita GDP was 10446.15 US dollars, the average urbanization ratio was 61.92%, the average years of education was 9.91, and the average Engel's coefficient was 31.49%.

3.2. Association between healthcare access and individual socioeconomic status

One-layer linear probability regression models were conducted to test the association between individual socioeconomic status and access to healthcare for people with disabilities (Table 2). Adjusting for age (log), Model 1, Model 2, and Model 3 showed that respondents with urban residence ($p < 0.001$), non-poverty status ($p < 0.001$), and higher education ($p < 0.001$) were more likely to access healthcare. For example, respondents with urban residence had 3.97% more probability to access healthcare than those with rural residence. However, in Model 5—which adjusted for covariates at the individual level, including sex, age (log), marriage, medical insurance, employment, and level and type of disability—non-poverty status was negatively associated with access to healthcare ($p < 0.001$), while urban residence ($p < 0.001$) and higher education ($p < 0.001$) were still positively associated with a higher probability of healthcare access. Further, we included the interaction term between residence and poverty status at the individual level. We found a significant disparity in the impact of poverty between urban and rural areas ($p < 0.001$). Specifically, for individuals living in urban areas with poverty, they had a lower possibility to access healthcare compared to individuals living rural areas with poverty.

3.3. Association between healthcare access and prefectural economic indicators

As Fig. 2 shows, the prevalence of healthcare access within each prefecture improved with the increase in the prefecture's per capita GDP (log), urbanization ratio, and average years of education, regardless the respondents' residence, poverty status, and education level (Fig. 2.1, Fig. 2.2, Fig. 2.3, Fig. 2.5, Fig. 2.6, Fig. 2.7, Fig. 2.9, Fig. 2.10, Fig. 2.11).

Table 1
Sample characteristics.

	Total		Accessed Healthcare		Not Accessed Healthcare	
	N = 778,568		N = 649,669		N = 128,899	
Individual variables	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD
Residence						
Rural = 0	502,827	64.58	411,912	63.40	90,915	70.53
Urban = 1	275,741	35.42	237,757	36.60	37,984	29.47
Poverty status						
Not poverty = 0	479,219	61.55	402,751	61.99	76,468	59.32
Poverty = 1	299,349	38.45	246,918	38.01	52,431	40.68
Education						
Illiterate = 1	103,900	13.35	83,260	12.82	20,640	16.01
Primary school = 2	223,293	28.68	184,226	28.36	39,067	30.31
Middle school = 3	301,720	38.75	252,246	38.83	49,474	38.38
Senior school = 4	117,054	15.03	101,604	16.64	15,450	11.99
College or above = 5	32,601	4.19	28,333	4.36	4268	3.31
Sex						
Female = 0	332,596	42.72	280,856	43.23	51,740	40.14
Male = 1	445,972	57.28	368,813	56.77	77,159	59.86
Age	51.40	11.05	51.70	10.95	49.93	11.41
Marriage						
Not in marriage = 0	231,184	29.89	192,152	29.76	39,032	30.57
In marriage = 1	542,134	70.10	453,503	70.24	88,631	69.43
Missing	5250		4014		1236	
Medical insurance						
Not have insurance = 0	209,039	26.85	182,156	28.04	26,883	20.86
Have insurance = 1	569,529	73.15	467,513	71.96	102,016	79.14
Employment						
Unemployed = 0	387,717	68.76	320,777	69.05	66,940	67.38
Employed = 1	176,165	31.24	143,757	30.95	32,408	32.62
Missing	214,686		185,135		29,551	
Disability level						
Mild = 0	413,687	53.13	343,088	52.81	70,599	54.77
Severe = 1	364,881	46.87	306,581	47.19	58,300	45.23
Disability type						
Physical = 1	418,337	53.73	346,985	53.41	71,352	55.35
Mental and intellectual = 2	197,530	25.37	168,147	25.88	29,383	22.80
Visual, hearing, and speech = 3	127,477	16.37	105,659	16.26	21,818	16.93
Multiple = 4	35,223	4.52	28,877	4.44	6346	4.92
Missing	1		1			
Prefectural variables (N = 324)						
Per capita GDP $	10446.15	5925.35				
Urbanization ratio (%)	61.92	13.46				
Average years of education	9.91	1.07				
Engel's coefficient (%)	31.49	7.58				

Note: CI: Confidence interval, SD: Standard Deviation.

Table 2
Associations between individual socio-economic status and access to medical services.

	Model 1	p	*Model 2*	p	*Model 3*	p	*Model 4*		*Model 5*		*Model 6*	
	β (95% CI)		β (95% CI)		β (95% CI)		β (95% CI)	p	β (95% CI)	p	β (95% CI)	p
Residence (ref = rural)												
Urban	3.97 (3.79, 4.14)	<0.001					2.80 (2.61, 2.99)	<0.001	0.52 (0.26, 0.77)	<0.001	2.21 (1.88, 2.53)	<0.001
Poverty status (ref = not poverty)												
Poverty			−0.82 (−0.99, −0.64)	<0.001			0.12 (−0.06, 0.29)	0.183	0.73 (0.51, 0.94)	<0.001	1.79 (1.54, 2.04)	<0.001
Education (ref = illiterate)												
Primary school					1.96 (1.69, 2.23)	<0.001	1.95 (1.67, 2.22)	<0.001	3.33 (2.99, 3.67)	<0.001	3.36 (3.02, 3.70)	<0.001
Middle school					3.25 (2.99, 3.51)	<0.001	2.74 (2.48, 3.01)	<0.001	5.15 (4.82, 5.48)	<0.001	5.22 (4.89, 5.56)	<0.001
Senior school					6.19 (5.88, 6.50)	<0.001	4.75 (4.43, 5.08)	<0.001	7.05 (6.64, 7.46)	<0.001	6.99 (6.58, 7.40)	<0.001
College and above					7.34 (6.88, 7.80)	<0.001	5.40 (4.92, 5.89)	<0.001	7.96 (7.39, 8.54)	<0.001	7.71 (7.13, 8.28)	<0.001
Residence × Poverty status												
Urban × Poverty											−3.64 (−4.09, −3.19)	<0.001
Age (log)	7.63 (7.31, 7.96)	<0.001	7.98 (7.65, 8.30)	<0.001	8.23 (7.91, 8.56)	<0.001	7.80 (7.46, 8.13)	<0.001	8.99 (8.52, 9.46)	<0.001	8.90 (8.42, 9.38)	<0.001
Sex (ref = female)												
Male									−2.17 (−2.38, −1.96)	<0.001	−2.18 (−2.39, −1.96)	<0.001
Marriage (ref = not in marriage)												
In marriage									−0.84 (−1.09, −0.60)	<0.001	−0.90 (−1.15, −0.66)	<0.001
Medical insurance (ref = not have)												
Have									−2.84 (−3.11, −2.56)	<0.001	−2.32 (−2.60, −2.03)	<0.001
Employment (ref = unemployed)												
Employed									−0.08 (−0.32, 0.15)	0.473	−0.09 (−0.33, 0.14)	0.420
Disability level (ref = mild)												
Severe									2.33 (2.11, 2.55)	<0.001	2.31 (2.09. 2.53)	<0.001
Disability typle (ref = physical)												
Mental and intellectual									4.52 (4.26, 4.7)	<0.001	4.48 (4.22, 4.73)	<0.001
Visual, hearing, and speech									−0.31 (−0.61, −0.01)	0.042	−0.32 (−0.62, −0.02)	0.034
Multiple									0.95 (0.45, 1.44)	<0.001	0.94 (0.44, 1.43)	<0.001

Note: All models adjusted for age (log). Models 1–3 tested the association between residence, poverty status, and education, respectively, and the access to healthcare at the individual level. Model 4 included these three dependent variables simultaneously, while Model 5 also included covariates such as sex, age (log), marriage, medical insurance, employment, and the level and type of disability, Model 6 further controlled for the interaction between residene and poverty status.

However, the box charts did not show an obvious association between the prevalence of healthcare access and Engel's coefficient for each prefecture (Fig. 2.4, Fig. 2.8, Fig. 2.12).

In terms of multilevel regression models, consistent with the results in Table 2, the results in Table 3 show that respondents with urban residence ($p < 0.05$), poverty status ($p < 0.001$), and higher education ($p < 0.001$) were more likely to access healthcare. Moreover, for prefectural economic indicators, per capita GDP ($p < 0.001$), urbanization ratio ($p < 0.001$), and average years of education ($p < 0.001$) were positively associated with a higher probability of accessing healthcare for respondents at the individual level. For example, an increase of one percentage in the prefecture's urbanization level was accompanied by a 0.42% increase in the probability of accessing healthcare at the individual level. However, the association between the prefecture's Engel's coefficient and healthcare access at the individual level was not significant ($p > 0.05$).

4. Discussion

This study used survey data from mainland China including 778,568

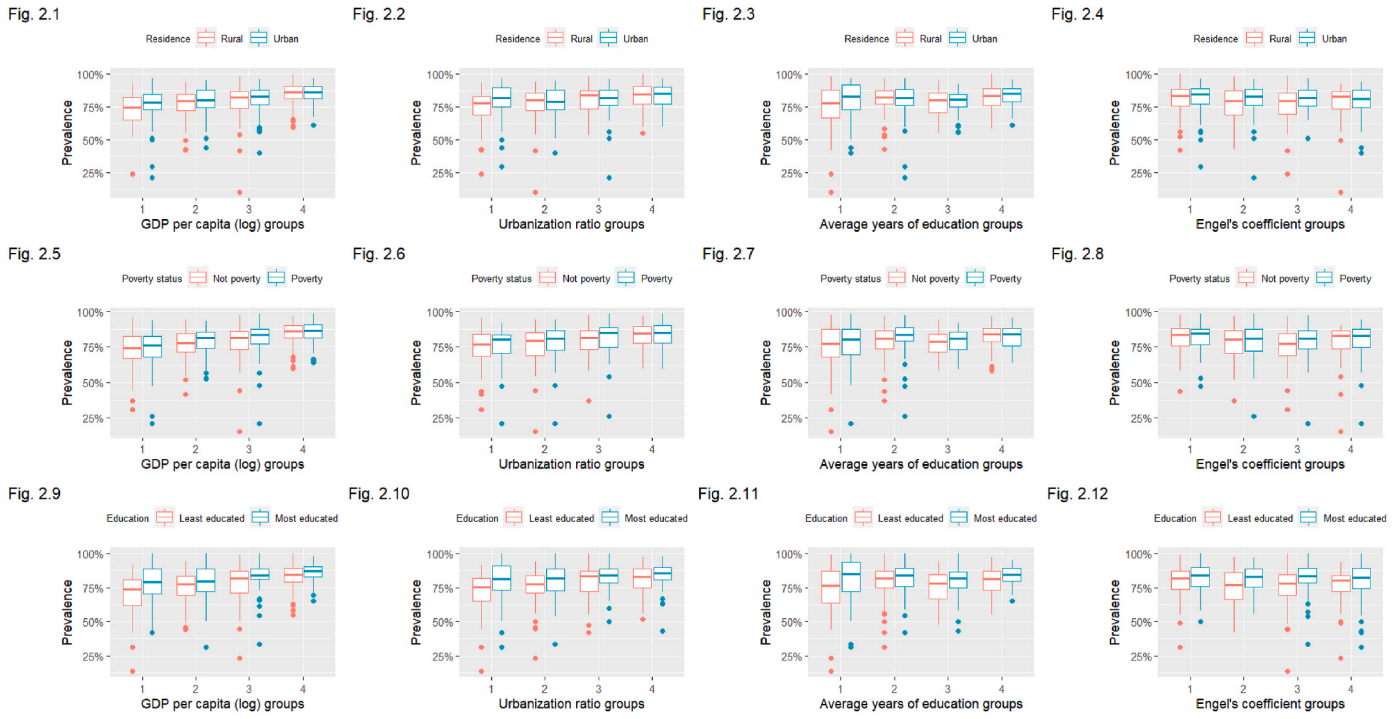

Fig. 2. Association between prevalence of medical service access and economic indicators for each prefecture
Note: Prefectures were divided into four quarter groups (Group 1 for the first quarter, Group 4 for the last) over economic indicators, including per capita GDP (log), urbanization ratio, average years of education, and Engel's coefficient.

Table 3
Association between prefectural economic indicators and the access to medical services for people with disabilities.

	Model 1		Model 2		Model 3		Model 4	
	β (95% CI)	p	β (95% CI)	p	β (95% CI)	p	β (95% CI)	p
Residence (ref = rural)								
Urban	1.20 (0.11, 2.30)	0.031	1.19 (0.09, 2.28)	0.034	1.23 (0.13, 2.32)	0.028	1.26 (0.16, 2.36)	0.024
Poverty status (ref = not poverty)								
Poverty	2.06 (1.56, 2.55)	<0.001	2.05 (1.56, 2.55)	<0.001	2.05 (1.56, 2.55)	<0.001	2.04 (1.55, 2.54)	<0.001
Education (ref = illiterate)								
Primary school	2.78 (2.36, 3.21)	<0.001	2.78 (2.36, 3.20)	<0.001	2.78 (2.36, 3.20)	<0.001	2.79 (2.37, 3.21)	<0.001
Middle school	4.56 (4.13, 4.99)	<0.001	4.56 (4.13, 4.99)	<0.001	4.56 (4.13, 4.99)	<0.001	4.57 (4.15, 5.00)	<0.001
Senior school	5.67 (5.15, 6.19)	<0.001	5.67 (5.15, 6.20)	<0.001	5.68 (5.16, 6.20)	<0.001	5.69 (5.13, 6.21)	<0.001
College and above	6.73 (5.94, 7.52)	<0.001	6.74 (5.95, 7.53)	<0.001	6.73 (5.94, 7.52)	<0.001	6.75 (5.96, 7.54)	<0.001
Fixed effects of prefectural economic indicator								
Per capita GDP (log)	12.56 (10.00, 15.11)	<0.001						
Urbanization ratio			0.42 (0.32, 0.53)	<0.001				
Average years of education					4.72 (3.11, 6.34)	<0.001		
Engel's coefficient							−0.02 (−0.21, 0.17)	0.839

Note: Models 1–4 tested the association between four economic indicators at the prefectural level, respectively, and access to healthcare at the individual level. All models adjusted for covariates, including sex, age (log), marriage, medical insurance, employment, and the level and type of disability.

respondents aged 18 to 65 in 31 provinces and 324 prefecture-level cities. Individual data from the survey were merged with prefecture-level economic indicator data for statistical analysis, which included linear probability regressions, ecological analysis, and multilevel regression models. This study found, first, that individual socioeconomic status was associated with access to healthcare for people with disabilities in China. Respondents with urban residence status or higher education levels were significantly more likely to access healthcare than those with rural residence status or lower educational levels ($p < 0.001$). Individuals' residence status and education level could be considered as fundamental health causes (Link & Phelan, 1995); respondents with urban residency or higher educational levels are more likely to have more monetary or social resources to access healthcare than those in rural settings or with lower education levels. This study's results showed that people with disabilities living in poverty were more likely to access healthcare than those not living in poverty n, even after controlling for covariables at the individual level and prefectural effects. This finding is inconsistent with several prior studies in China and other countries, which found that poverty reduced access to healthcare among people with disabilities (Flores-Flores et al., 2018; Guo et al., 2019). This could be explained by the Poverty Alleviation Strategy, a series of assistance policies for those living in poverty implemented by the Chinese government since 2015 to eradicate absolute poverty nationally. By the end of 2020, more than seven million people with disabilities had been lifted out of absolute poverty (Xinhua, 2021). Under the Strategy, people with disabilities identified as living in "poverty" were provided with subsidies and other types of assistance in healthcare utilization (Wang et al., 2022). However, although there appears to be an association between these poverty alleviation strategies and health service utilization among people with disabilities, the causal relationship between poverty

alleviation and access to healthcare at the individual level for people with disabilities still needs further investigation. Notably, in Table 2, the coefficient of "poverty" was negative in Model 2, but positive in Model 5–6 and Table 3's models. Since multicollinearity test showed all the VIF values were below 3, this is not caused by multicollinearity. Instead, this could be caused by the suppression effect brought by other variables (Beckstead, 2012).

Second, prefectural economic indicators, including per capita GDP, urbanization ratio, and average educational years, were positively associated with the overall prevalence of healthcare access within the prefectures, as well as the probability of people with disabilities accessing healthcare at the individual level in China, even when controlling for covariables. This finding is consistent with a prior study (Wang et al., 2018) which found that regional economic development was positively associated with accessibility to primary health care for the whole population. This finding provides evidence for the positive association between regional economic development and healthcare access for people with disabilities. It also suggests that regional economic growth may result in better healthcare provisions at the local level for people with disabilities. Local economic growth may bring more monetary resources, like tax revenues, for local government to input into the healthcare sector; access to healthcare improves with increased healthcare provision (Jolidon et al., 2021). However, a reverse causal relationship between healthcare improvement and economic development could also exist. For example, a prior study found that improved population health, regarded as "health capital," could facilitate economic growth based on data from 1978 to 2003 in China (Gong et al., 2012). This study found a positive association between healthcare accessibility for people with disabilities and local human capital, as demonstrated by the prefecture's average years of education. Many studies have shown a positive relationship between education at the macro level and economic development (Benos and Zotou, 2014). The precise causal relationships between regional economic growth, education, and human capital, and healthcare accessibility still need further exploration.

In contrast to the other three economic indicators, the association between prefectural Engel's coefficient and individual access to healthcare was not found to be significant in our analysis. Engel's coefficient could indicate the long-term economic development at the macro level. Notably, Engel's coefficient and GDP per capita are distinct variables. The relationship between Engel's coefficient and economic growth is not purely linear and is subject to various influencing factors, such as market dynamics, inflation, and income levels (Yu, 2018).

This study also demonstrates the efficiency of multilevel models in exploring social determinants of health with hierarchical data. For example, as shown by the results in Fig. 2 and Table 3, there were obvious differences between the average probabilities of healthcare access across cities at different economic levels. Thus, by estimating the effects of different levels simultaneously, multilevel models can more robustly deal with "nested" structured data than one-layer regression models (Peugh, 2010).

This study has some health policy implications for people with disabilities. First, besides public policies, local governments need promote economic growth to improve healthcare accessibility, especially for vulnerable groups in low- and middle-income countries. As this study suggests, local economic growth may contribute to the improvement of healthcare accessibility and a decrease in healthcare access inequalities for vulnerable groups. Other than specialized healthcare or equity policies, economic growth is still important for promoting population well-being and social equity, especially in low- and middle-income countries where healthcare infrastructure is oftentimes inadequate. Second, we emphasize the importance of poverty alleviation. The results of this study implicate that the Chinese government's Poverty Alleviation Strategy has given poor people with disabilities advantages in accessing healthcare. This successful poverty alleviation could be an example for other low- and middle-income countries to achieve Sustainable Development Goals globally. Third, it is essential to establish a monitoring system of healthcare utilization and health status for vulnerable groups. An updated well-being monitoring system for vulnerable groups would help inform policies and promote social equity.

However, this study also has some limitations. First, only cross-sectional data were used for statistical analysis. Our findings about the association between prefectural economic indicators and individual access to healthcare cannot lead to any causal relationship. Future studies may use longitudinal data or experimental/quasi-experimental research designs to test the causal relationship between regional economic growth and individual access to healthcare. Second, due to data source restrictions, our models did not include some individual-level variables, such as income level and long-term conditions, that could influence healthcare access among people with disabilities. Third, some of this study's findings may not be generalizable. For example, it found that people with disabilities in China living in poverty were more likely to access healthcare than those in general after controlling covariables and prefectural effects, hypothesizing that this was likely due to the Poverty Alleviation Strategy conducted by the Chinese government, which afforded vulnerable people extra subsidies and social assistance, thereby improving their healthcare access. Therefore, this study's implications may not apply to other settings where such policies have not been administered.

5. Conclusions

This study explored the potential influences of individual socioeconomic status and the prefectural economic indicators on access to healthcare for people with disabilities. It is found, first, that individual socioeconomic status was associated with access to healthcare for people with disabilities in China. Respondents with urban residence or higher education levels were more likely to access healthcare when ill than those with rural residence or lower education levels. Respondents with poverty status were more likely to access healthcare than those with non-poverty status. Second, prefectural economic indicators, including per capita GDP (log), urbanization ratio, and average years of education, were positively associated with the probability of healthcare access at the aggregate and individual levels. This study highlights the importance of economic development and poverty alleviation to improve healthcare accessibility for those living with disabilities, especially in low- and middle-income countries.

Ethical statement

No ethical approval was required for this study.

Declaration of generative AI in scientific writing

No AI tools were used in this work. The author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Submission declaration and verification

This work has been never published previously.

CRediT authorship contribution statement

Hongchuan Wang: Conceptualization, Supervision, Writing – review & editing, Writing – review & editing. **Zhe Chen:** Formal analysis, Software, Writing – original draft, Writing – review & editing. **Zhihui Li:** Funding acquisition, Methodology, Supervision, Writing – review & editing. **Xiaofeng He:** Data curation, Methodology. **S.V. Subramanian:** Conceptualization, Writing – review & editing.

Declaration of competing interest

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Data availability

The data used cannot be shared unless applicants secure the relevant permissions..

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