Hindawi
Health & Social Care in the Community
Volume 2023, Article ID 3830723, 13 pages
https://doi.org/10.1155/2023/3830723

Research Article

The Effect of Health Education on Migration Health: Evidence from a Large Migrant Survey in China

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Received 3 March 2023; Revised 26 July 2023; Accepted 29 July 2023; Published 24 August 2023

Academic Editor: Zhiyong Lin

Reducing health inequities for migrants is a huge challenge shared globally. Based on big data of China Migrants Dynamic Survey in 2017, this paper applied Ordered Logit models and Logit models to examine the effect of health education on the health of migrants. Propensity score matching and instrumental variable were also employed to solve the endogenous problem. This paper found a significant health promotion effect of health education on the health of migrants, which remained significant after a series of robustness check. Further analysis showed that consultative health education is more effective than nonconsultative health education. Meanwhile, the positive association between health education and migrants' health behavior was identified which provided empirical evidence for knowledge, attitude, and practices theory. Heterogeneity analyses supported that health education has a stronger effect on migrants who were female, elderly, highly educated, and did not have chronic diseases than on those who were male, younger, less educated, and had chronic diseases. This paper demonstrates that health education is an important health promotion factor for migrants empirically and that the government should take actions to provide sufficient and targeted health education for migrants to promote their health.

1. Introduction

Migrants are integral to the contemporary social, political, and economic world [1, 2]. According to the National Bureau of Statistics of China, there are 385 million migrants in 2021, accounting for 27.23% of China's total population. These large-scale migrants contribute a lot to the unprecedented economic growth and urbanization in China [3, 4]. However, their health is in a disadvantaged situation compared to that of the residents in their inflow cities [5, 6]. On the one hand, the migrants are exposed to higher health risks due to the education level, occupational characteristics, and other factors; several studies have demonstrated that the migrants are susceptible to many diseases, such as infectious, occupational, and chronic diseases as well as psychological disorders [7–9], and have a lower level of medical service utilization as well [10–12]. On the other hand, the mass movement of migrants has led to an increasing impact on public health. Improving migrant health is not only conducive to boosting productivity, human capital supply, and reducing health inequities but also having a positive spillover effect on the health level of society as a whole. How to effectively intervene to improve the health of migrants has become an important issue for academia and policy makers.

Existing studies focus on the barriers and problems that the health care system creates in migrants' access to healthcare and the resulting poor health outcomes [13]. For example, China's medical insurance system and household registration system (also known as "Hukou") make it more difficult for migrants to access healthcare [14–17].

The Chinese government has implemented the equalization of basic public health service and made efforts to include migrants in local social insurance, which reduced the health inequalities and improved the quality and accessibility of medical services for migrants and promoted their health [18, 19]. But there remain disparities, and more importantly, migrants are not well-aware of health and face obstacles in how to access healthcare [20]. Lack of ability to access and understand basic health information is considered a sign of low health literacy [21, 22]. People with low health literacy are unable to make appropriate decisions to maintain and promote health [23]. This has led to an increasing interest in health education in both public health policy and research. The importance of health education in responding to the challenges of the public health system and the development needs of modern societies is increasingly recognized [24].

Health education refers to organized and systematic social education activities and is considered as an effective way to gain health knowledge [25, 26]. Research shows that health education is an efficient way to optimize people's healthcare-seeking behavior and promote their health [27, 28]. The earliest Stanford Five-City Project revealed the influence of health education in promoting health through a field experiment that found that community health education led to improvements in basic health indicators such as blood pressure [29]. Subsequent literature consistently found the effect of health education in preventing disease and enhancing health. For example, the Chinese government has virtually controlled sexually transmitted diseases and significantly reduced neonatal mortality through sustained health education programs [30]. A recent intervention experiment at Wuhan University in China demonstrated that health education was effective in improving health behaviors among Chinese college students, and those intervened performed higher levels of activity and a more regular diet [31]. Similarly, migrant health education is often conceptualized in very practical ways, such as mechanisms to promote migrant integration or improve health care [25, 32]. Health education initiatives for 487 high-risk migrants in Spain from 2007 to 2010 reduced the fear of Chagas disease and increased the screening rate among them [33]. Another health education for 169 European migrants through mobile phone messages not only improved migrants' attitudes towards HIV but also their physical activity levels, diet, and stress management [34]. Generally, the ultimate goal of health education is to positively influence health status, but since health education generally works through intermediate outcomes, such as screening rates and health indicators, there is limited literature directly examining the health promotion effects of health education among migration.

Although studies have suggested the effectiveness of health education in promoting health, considering the diverse life experiences of migrants and the broader social, psychological, emotional, economic, and environmental factors that influence their health and well-being, we still know little about the extent to which health education promotes the health of migrants. Most existing migration studies explored the impact of health education on the prevention and improvement of a particular disease among migrants through small sample interventions, and there is a continued lack of examination of the overall impact of health education on the health of migrants, especially in the context of the overall national migration population. Therefore, this study aims to examine the extent to which health education promotes the health of migrants with a large sample of migration survey data from China.

The knowledge, attitude, and practices (KAP) theory contributes to a theoretical understanding of how health education promotes migration health. The KAP theory, which has widely guided practice in health education and public health, holds that knowledge are antecedent element in promoting behavior [35]. KAP theory divides human behavior into three processes: acquiring knowledge, generating attitude, and forming behaviors. It is considered that health knowledge is the basis for forming correct and positive health attitudes, and good health attitudes are the motivation for changing behaviors. By receiving health education, migrants can acquire scientific health knowledge, eliminate misconceptions and doubts about health, and improve their rational understanding of health and disease. The abundance of health knowledge has an impact on the health attitudes of migrants, leading to the development of health-consciousness and a positive and optimistic health attitude. The goal of health education is to influence and change health behaviors and help migrants develop healthier habits and lifestyles. For example, they would reduce alcohol and tobacco use, have regular medical checkups, and take a healthier lifestyle to prevent disease [36]. Taken together, health education increases health knowledge, shapes health attitudes, and ultimately enhances the health of migrants by fostering their health behaviors.

This study aims to use large sample data from Chinese migrants to scientifically answer a series of questions about the extent to which health education promotes the health of migrants, which health education methods are more effective, and whether health education has heterogeneous effects on migrants with different characteristics. This study enriches the understanding of the factors affecting the health of migrants and contributes to the development of policies that improve the health of migrants.

2. Materials and Methods

2.1. Data Source. This study uses data from 2017 China Migrants Dynamic Survey (CMDS), conducted by the National Health Commission (NHC), P.R. China. According to the official technical documentation from NHC, the CMDS subjects are migrants who have lived in the inflow cities for more than one month but do not have a local Hukou. These migrants are from 31 provinces, autonomous regions, municipalities, and the Xinjiang Production and Construction Corps and aged over 15. The survey is convened by the local health commission with the Probability Proportional to Size (PPS) method for sampling. It includes detailed information on migrant households, employment, and health, and its scientific sampling design and large data sample ensure a unique national representation. After

excluding samples with missing information on relevant variables, the sample of this study contains 151,086 observations.

2.2. Variable Definition. The key dependent variable in this study is the health status of the migrants. Self-rated health (SRH) is used to measure the health of the migrants, which is commonly applied in health research [37–39]. Respondents answer the question "How is your health status" by selecting options 1–4, where 1 indicates "Unable to self-care," 2 "Unhealthy," 3 "Basically healthy," and 4 "Healthy." In short, the larger the number is, the healthier the migrants are. We also used data from 2018 CMDS to replace the explanatory variables. Specifically, we generated a binary variable illness to measure the health of migrants based on whether they had been ill and injured in the past year. If the migrant had no illness or injury in the past year, illness = 0 and otherwise illness = 1.

Health education is the core explanatory variable in this study. According to 2017 CMDS, respondents are asked to answer, respectively, "In the past year, did you receive health education on occupational diseases/AIDS/reproductive health and contraception/tuberculosis/smoking/mental health/chronic diseases/maternal and child health/self-help in public emergencies?". A dummy variable is established for health education by taking the migrants who have received one or more kinds of the above health education as educated, coded as "1," and otherwise "0."

To further examine the impact of different health education approaches, this paper classifies health education approaches into consultative and nonconsultative categories. According to the 2017 CMDS, there are six methods of health education, containing lectures, promotion materials, bulletin boards and electronic displays, community SMS/WeChat/website, public health consultation, and individual consultation. We classified public health counseling and individual counseling as consultative health education and other methods as nonconsultative health education.

This study measured health behavior based on migrants' medical service utilization after illness. First, we examined migrants' medical service utilization for specific diseases. If a migrant made use of medical services after having a diarrhea/fever/rash/jaundice/conjunctival swelling/cold, it will be coded as 1 and otherwise as 0. To overall examine the health behavior of migrants, we constructed a binary variable MSU1, which represents the medical services utilization if the migrant made use of them after suffering from any of the above diseases, MSU1 = 1 and otherwise MSU1 = 0. Alternatively, we examined the medical service utilization of migrants after their most recent illness (injury) and constructed a variable, MSU2, from this. MSU2 = 0 if migrant was not treated after illness, and MSU2 = 1 if migrant took treatment at a community health post, clinic, hospital, or other place.

To investigate the effect of health education on the health of migrants, referring to other studies [6, 40, 41], we also controlled for other control variables such as gender, age, and education level of the migrants. Detailed variable definitions are presented in Supplementary Table S1.

Descriptive statistics are shown in Table 1. In terms of health education, 26.80% of the migrants did not receive any health education and 73.09% received at least one type of health education. The migrants who received health education were treated as the treatment group and those who did not were the control group with the dependent variable SRH varying between the treatment and control groups. Table 2 reports the disparity in SRH between the treatment and control groups. It could be found that, compared to the migrants who received health education, the migrants who did not receive any health education have a significantly worse SRH, which is statistically significant at the 1% level.

2.3. Estimation Models. We conducted regression analysis to examine the effect of health education on the health of migrants. As the dependent variable SRH_i is an ordinal variable, we performed an ordered logit model in the baseline regression, and the model is as follows:

$$\mathrm{SRH}_i^* = \alpha + \beta \mathrm{HealthEdu}_i + \gamma X_i' + \lambda_j + \varepsilon_i,$$

$$\mathrm{SRH}_i = \begin{cases} 1 & \text{if } \mathrm{SRH}_i^* \le \mu_1 \quad \text{(Unable to self - care)}, \\ 2 & \text{if } \mu_1 < \mathrm{SRH}_i^* \le \mu_2 \quad \text{(Unhealthy)}, \\ 3 & \text{if } \mu_2 < \mathrm{SRH}_i^* \le \mu_3 \quad \text{(Basically healthy)}, \\ 4 & \text{if } if\ \mu_3 < \mathrm{SRH}_i^* \quad \text{(Healthy)}, \end{cases} \tag{1}$$

where SRH_i^* is the latent SRH of migrant i, which is mapped to the observed SRH_i through the cutoff point μ_j that are estimated together with β and satisfied with $\mu_1 < \mu_2 < \mu_3$. $\mathrm{HealthEdu}_i$ is the explanatory variable that we are interested in, representing the health education received by migrant i. X_i' is a column vector of control variables that may affect the SRH of migrants, including gender, age, education, ethnicity, chronic diseases, work industry, insurance, marriage, and income. λ_j is the city fixed effect, and ε_i is the residual term. Furthermore, this study is interested in the marginal treatment effect (MTE) of health education, i.e., how health education affects the probability of the migrants' SRH taking each value when other control variables are at the mean. Following the methods of Aakvik et al. [42] and Huang et al. [43], we estimated the MTE of health education on the health of migrants based on the above benchmark model.

To enhance the reliability of the estimation, we estimated the effect of health education on the health of migrants again using a multiple linear model. Although the independent variables in this study are ordered variables, following the experience of empirical analysis, the robustness of the study findings could be enhanced if the multiple linear model could reach similar estimation results [44]. The model is as follows:

$$\mathrm{SRH}_i = \alpha + \beta \mathrm{HealthEdu}_i + \gamma X_i' + \lambda_j + \varepsilon_i. \tag{2}$$

Table 1: Descriptive statistics.

Variables	Definition	Obs	Mean (%)	S.D.	Min	Max
Explained variable						
SRH	Unable to self-care = 1	155	0.10	0.474	1	4
	Unhealthy = 2	4,026	2.66			
	Basically healthy = 3	22,940	15.18			
	Healthy = 4	123,965	82.05			
Illness	No = 0	134,600	88.61	0.318	0	1
	Yes = 1	17,298	11.39			
Explanatory variable						
Healthedu	No = 0	40,489	26.80	0.443	0	1
	Yes = 1	110,597	73.20			
Control variables						
Gender	Female = 0	73,468	48.63	0.500	0	1
	Male = 1	77,618	51.37			
Age	Year	151,086	37.312	11.01	16	97
Education	Year	151,086	10.159	3.420	0	19
Ethnicity	Minority = 0	13,607	9.01	0.286	0	1
	Han ethnicity = 1	137,479	90.99			
C diseases	No = 0	142,271	94.17	0.234	0	1
	Yes = 1	8,815	5.83			
Industry	Unemployment	27,131	17.96	1.110	0	1
	Primary industry	3,024	2.00			
	Secondary industry	43,537	28.82			
	Tertiary industry	77,394	51.23			
Insurance	No = 0	109,914	72.75	0.445	0	1
	Yes = 1	41,172	27.25			
Marriage	Unmarried = 0	25,828	17.09	0.376	0	1
	Married = 1	125,258	82.91			
Income	Log of 1000 CNY	151,086	1.959	0.521	0	5.303
MSU1	No = 0	55,832	59.94	0.490	0	1
	Yes = 1	37,308	40.06			
MSU2	No = 0	12,804	17.24	0.378	0	1
	Yes = 1	61,459	82.76			
Instrumental variable						
HEBB	Number of health education bulletin boards	127,086	3.780	3.950	0	30

Note: (1) education level is a continuous variable, specifically, less than elementary = 0, elementary school = 6, middle school = 9, senior middle school/technical secondary school = 12, junior college = 15, undergraduate = 16, and postgraduate = 19. (2) MSU1 is an overall indicator of medical service utilization for migrants after specific diseases, and MSU2 is an indicator of medical service utilization for migrants after the most recent illness.

Table 2: The gap in SRH between the migrants with and without health education.

Variables	Health education				T-test
	No		Yes		
	Mean	S.D.	Mean	S.D.	Diff
SRH	3.749	0.475	3.802	0.493	−0.052***

Note: *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

In this equation, SRH_i represents the SRH of migrant i. α is a constant. $HealthEdu_i$ represents the health education received by migrant i. X_i' is the same set of control variables as Model (1). λ_j is the city fixed effect. ε_i is the residual term, and to mitigate the heteroskedasticity problem, we used robust standard errors in the estimation [45].

Since medical service utilization of migrants is a binary variable, we performed a logit model to test whether health education promotes medical service utilization among migrants, and the model is as follows:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta \text{HealthEdu}_i + \gamma X_i' + \lambda_j + \varepsilon_i, \quad (3)$$

where p_i is the probability that medical service utilization occurs after the illness of migrant i, and $1 - p_i$ is the probability that medical service utilization does not occur. The other variables are the same as in Model (1).

To alleviate the potential endogeneity problem, we first used propensity score matching (PSM) to mitigate the problem of self-selection. In practice, receiving health education is a result of migrants' self-selection and thus might lead to a selection bias in the estimation. In view of this, this paper corrected the problem of self-selection bias by PSM. Referring to the standard proposed by Smith and Todd [46], this study selects the following control variables for matching: Gender, Age, Education, Marriage, Hukou, and Insurance. Another potential concern is that migrants who have a better awareness of health may be healthier, and perhaps, these migrants would also be more willing to receive health education. This potential endogeneity may lead to a bias in our estimation, and thus, we address this issue by instrumental variable (IV). To be specific, we take the number of health education bulletin boards in communities where the migrants live as the IV [25], which meets the requirement of relevance and exclusion. On one hand, the number of health education bulletin boards reflects the extent to which migrants' community values health education and more bulletin boards indicate a greater probability that migrants would receive health education information, suggesting that the IV is correlated with health education. On the other hand, health education bulletin boards in communities do not directly promote migrants' health, satisfying the requirement of exclusion. Since the community data for the 2017 CDMS were not available, we used the community data for 2018 CMDS as a substitute and matched it with the 2017 CMDS by community codes.

3. Results

3.1. Benchmark Regression and Robust Test. Table 3 reports the key regression results. The regression results indicate that health education had a significant positive impact on the health of Chinese migrants. To be specific, the regression results in Column 1 based on the ordered logit model illustrate that the migrants who received health education are more likely to have a higher SRH. The probability of one-level improvement in SRH is 1.169 times higher for migrants who received health education than those who did not, and this effect is significant at the 1% level. Meanwhile, the results of the marginal effects analysis reveal the effect of receiving health education on the probability of migrants' SRH taking each value when the other control variables are at mean values. Receiving health education significantly decreased the probability of having migrants SRH of "unable to self-care," "unhealthy," and "basically healthy," while increasing the probability of having migrants SRH of "healthy" by 2%. Furthermore, the estimation results under the multiple linear models in Column 2 show that receiving health education leads to a significant increase in the SRH of the migrants with other control variables' constant. On the other hand, to increase the reliability of the baseline regression results, we used data from 2018 CMDS to make substitutions for the dependent variable. Specifically, we measured the health of migrants using the probability of being ill or injured. The results in Column 3 suggest that migrants who received health education were only 0.742 times likely to be ill and injured than those who did not, meaning that health education significantly reduced the risk of illness and injury among migrants. This result has the same implication as the baseline regression results that health education could improve the health of migrants.

3.2. Solving the Problem of Endogeneity. The abovementioned empirical results indicate that health education has a positive effect on the SRH of migrants. Furthermore, we alleviated potential endogeneity problems through PSM and IV to increase the reliability of the results. First, propensity scores are estimated by the logit model and matching is performed through the 1 : 1 nearest-neighbor within caliper method ($k = 1$, caliper = 0.01). Supplementary Table S2 and Figure S1 show the test results of the control variables before and after matching. The results show that the P value of all the matched (M) variables is greater than 0.1 and all differences in control variables between the treatment and control groups are not statistically different from zero after matching. Thus, there is no significant difference between the treatment and control groups, and the parallel hypothesis is verified. As shown in Figure 1, the kernel density distribution between the treatment and control groups tended to coincide after matching; thus, the common support hypothesis is satisfied. Therefore, the matching works well and the comparability of the matched samples is enhanced. Columns 1 and 2 of Table 4 show the regression results of the matched samples. The regression coefficients of health education remain positive and significant. This demonstrates that the results of the baseline regression are still valid after mitigating the selective bias and that health education could improve migration health.

Second, we further reduce endogeneity through the IV method. As mentioned above, we use the number of health education bulletin boards in communities where the migrants live as the IV. The results of IV regression are displayed in Column 3 of Table 4. The P value for the unidentifiable test is 0.000, which means that the IV is highly correlated with the explanatory variable. The weak identification test shows that the Kleibergen-Paap rk Wald F value of 263.799 is much greater than the empirical criterion of 10, representing that the IV is strong. These tests illustrate that the IV we selected is effective. In the IV model, the estimated coefficient of health education is 0.195 and significant at the 1% level, supporting that health education has health promotion effectiveness for migrants.

3.3. Further Analysis on the Methods of Health Education. Based on the abovementioned empirical results, we are similarly interested in which method of health education is more effective. According to the way health education is conducted, we classify health education into consultative and nonconsultative categories. The results presented in Table 5 demonstrate that both types of health education

Table 3: Effect of health education on the health of migrants.

Variables	SRH	(1) Ordered logit model Marginal effects				(2) OLS model	(3) Logit model
		Unable to self-care	Unhealthy	Basically healthy	Healthy	SRH	Illness
Healthedu	1.169***	−0.000***	−0.004***	−0.016***	0.020***	0.028***	0.742***
	(0.020)	(0.000)	(0.000)	(0.002)	(0.002)	(0.003)	(0.015)
Gender	1.183***	−0.000***	−0.004***	−0.017***	0.021***	0.027***	0.746***
	(0.018)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.013)
Age	0.954***	0.000***	0.001***	0.005***	−0.006***	−0.009***	1.023***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Education	1.038***	−0.000***	−0.001***	−0.004***	0.005***	0.007***	0.995*
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Ethnicity	1.128***	−0.000***	−0.003***	−0.012***	0.015***	0.012***	0.887***
	(0.029)	(0.000)	(0.001)	(0.003)	(0.003)	(0.004)	(0.026)
Cdisease	0.243***	0.001***	0.034***	0.142***	−0.177***	−0.409***	—
	(0.006)	(0.000)	(0.001)	(0.003)	(0.003)	(0.008)	—
Primary industry	1.263***	−0.000***	−0.007***	−0.027***	0.034***	0.092***	0.550***
	(0.060)	(0.000)	(0.001)	(0.005)	(0.007)	(0.011)	(0.033)
Secondary industry	1.653***	−0.001***	−0.013***	−0.055***	0.069***	0.127***	0.495***
	(0.037)	(0.000)	(0.001)	(0.003)	(0.003)	(0.004)	(0.013)
Tertiary industry	1.670***	−0.001***	−0.013***	−0.056***	0.070***	0.126***	0.454***
	(0.032)	(0.000)	(0.001)	(0.002)	(0.003)	(0.004)	(0.010)
Insurance	0.917***	0.000***	0.002***	0.009***	−0.011***	−0.024***	1.259***
	(0.017)	(0.000)	(0.000)	(0.002)	(0.002)	(0.003)	(0.025)
Marriage	0.967	0.000	0.001	0.003	−0.004	0.035***	0.934***
	(0.022)	(0.000)	(0.001)	(0.002)	(0.003)	(0.003)	(0.022)
Income	1.392***	−0.000***	−0.008***	−0.033***	0.041***	0.058***	0.904***
	(0.023)	(0.000)	(0.000)	(0.002)	(0.002)	(0.003)	(0.017)
Cons	—	—	—	—	—	3.815***	0.186***
	—	—	—	—	—	(0.009)	(0.015)
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	151,086	151,086	151,086	151,086	151,086	151,086	151,898
R^2/pseudo R^2	0.125	0.125	0.125	0.125	0.125	0.194	0.049

Note: (1) *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. (2) The numbers in parentheses are robust standard errors. (3) The coefficients in columns 1 and 3 are presented as odds ratio.

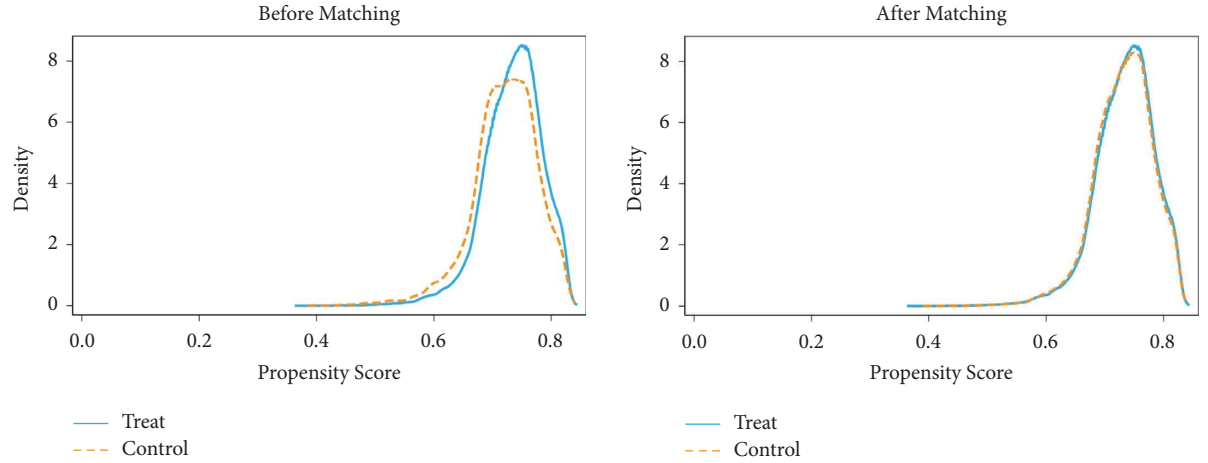

Figure 1: Kernel density of the treatment and control groups.

Table 4: Regression results after mitigating endogeneity.

Variable	SRH	(1) Ordered logit model Marginal effects				(2) OLS model	(3) 2SLS model
		Unable to self-care	Unhealth	Basically healthy	Health	SRH	SRH
Healthedu	1.170***	−0.000***	−0.004***	−0.016***	0.020***	0.028***	0.195***
	(0.020)	(0.000)	(0.000)	(0.002)	(0.002)	(0.003)	(0.060)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	149,040	149,040	149,040	149,040	149,040	149,040	127,086
R^2/PseudoR^2	0.121	0.121	0.121	0.121	0.121	0.186	0.131

Note: (1) *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. (2) The numbers in parentheses are robust standard errors. (3) The coefficients in column 1 are presented as odds ratio.

Table 5: Effects of different health education methods on the health of migrants.

Variable	(1) Ordered logit model	(2)
	Noncounseling	Counseling
Healthedu	1.077***	1.265***
	(0.020)	(0.025)
Gender	1.207***	1.187***
	(0.023)	(0.023)
Age	0.953***	0.954***
	(0.001)	(0.001)
Education	1.035***	1.041***
	(0.003)	(0.003)
Ethnicity	1.160***	1.126***
	(0.038)	(0.037)
Cdisease	0.255***	0.240***
	(0.008)	(0.007)
Primary industry	1.453***	1.199***
	(0.085)	(0.069)
Secondary industry	1.719***	1.638***
	(0.048)	(0.045)
Tertiary industry	1.739***	1.666***
	(0.042)	(0.039)
Insurance	0.924***	0.929***
	(0.021)	(0.021)
Marriage	0.996	0.964
	(0.028)	(0.027)
Income	1.388***	1.376***
	(0.028)	(0.028)
City fixed effect	Yes	Yes
Observations	93788	97787
Pseudo R^2	0.128	0.133

Note: (1) *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. (2) The numbers in parentheses are robust standard errors. (3) The coefficients are presented as odds ratio.

method significantly improve the health of migrants, but consultative health education is more effective. Through consultative health education, the probability of one-level improvement in SRH is 1.265 times for migrants who received health education than those who did not. This effect is smaller under nonconsultative health education, at 1.077 times.

3.4. The Effect of Health Education on Health Behaviors. We separately examine the migrants' utilization of medical services after specific illness and the most recent illness. The results are presented in Table 6. In terms of specific diseases, health education significantly enhances the medical service utilization of migrants after suffering from diarrhea, fever, rash, and cold. Based on Column 7 of Table 6, migrants who received health education were 1.274 times more likely to have medical service utilization after an illness than those who did not receive health education. In terms of the most recent illness, based on Column 8 of Table 6, migrants who received health education were 1.237 times more likely to take advantage of medical services after their most recent illness than those who did not receive health education. The estimation results are similar after replacing the medical service utilization variable, strengthening the robustness of the estimates. Combined examination of migrants' medical service utilization after illness reveals that migrants who receive health education are more proactive in seeking treatment to protect their health after illness. That is, health education makes migrants more health conscious and more willing to adopt health behaviors.

3.5. Heterogeneity Analysis. Analysis of the effects of health education among migrants with different characteristics is important for future policy and research, and the extant literature found heterogeneous effects of health education according to characteristics of migrants such as gender, age, and education level [28, 47]. Therefore, we further explored the heterogeneous impact of health education among migrants with different characteristics by dividing the total sample according to gender, age, education, and chronic diseases to gain a deeper understanding of the impact of migration health education. The results of the grouped regressions based on the ordered logit model are reported in Table 7, and health education demonstrated

Table 6: Effect of health education on migrants' medical service utilization after illness.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Logit model							
	Diarrhea	Fever	Rash	Jaundice	Conjunctival swelling	Cold	MSU1	MSU2
Healthedu	1.296***	1.162***	1.254***	0.523	1.094	1.323***	1.274***	1.237***
	(0.048)	(0.042)	(0.078)	(0.240)	(0.085)	(0.024)	(0.021)	(0.028)
Gender	0.865***	0.934**	0.849***	1.322	0.693***	0.959***	0.930***	0.918***
	(0.028)	(0.030)	(0.047)	(0.556)	(0.048)	(0.015)	(0.013)	(0.019)
Age	1.006***	0.993***	0.998	1.051***	0.999	0.995***	0.994***	1.004 ***
	(0.002)	(0.002)	(0.003)	(0.020)	(0.003)	(0.001)	(0.001)	(0.001)
Education	0.978***	1.004	1.013	1.294***	0.996	0.988***	0.991***	0.970***
	(0.005)	(0.005)	(0.009)	(0.098)	(0.011)	(0.003)	(0.002)	(0.003)
Ethnicity	0.937	0.891**	0.821**	0.609	1.011	0.950*	0.934***	0.920**
	(0.051)	(0.048)	(0.078)	(0.405)	(0.117)	(0.025)	(0.023)	(0.037)
C disease	1.065	1.141**	0.785**	0.595	1.054	1.279***	1.355***	1.367***
	(0.064)	(0.071)	(0.078)	(0.313)	(0.113)	(0.040)	(0.040)	(0.062)
Primary industry	1.181	0.953	0.790	0.091***	0.914	1.214***	1.206***	1.038
	(0.125)	(0.098)	(0.139)	(0.081)	(0.169)	(0.064)	(0.060)	(0.077)
Secondary industry	1.078	0.964	0.865*	0.335*	0.754***	1.045*	0.996	1.201***
	(0.054)	(0.048)	(0.071)	(0.193)	(0.082)	(0.025)	(0.022)	(0.040)
Tertiary industry	0.946	0.833***	0.860**	0.350*	0.820**	0.874***	0.851***	1.001
	(0.042)	(0.037)	(0.063)	(0.210)	(0.076)	(0.018)	(0.017)	(0.029)
Insurance	1.117***	1.065*	1.310***	1.409	1.092	1.077***	1.114***	1.015
	(0.041)	(0.039)	(0.081)	(0.675)	(0.086)	(0.019)	(0.018)	(0.024)
Marriage	0.949	0.981	0.950	1.978	0.947	1.023	0.997	1.054*
	(0.042)	(0.043)	(0.074)	(1.057)	(0.091)	(0.022)	(0.020)	(0.031)
Income	0.999	1.058***	1.094	0.494	1.096	0.991	1.001	0.909***
	(0.033)	(0.035)	(0.061)	(0.244)	(0.075)	(0.016)	(0.015)	(0.020)
Cons	0.331***	1.026	1.437	0.131	0.695	0.565***	0.734***	4.383***
	(0.052)	(0.154)	(0.379)	(0.180)	(0.227)	(0.041)	(0.050)	(0.422)
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,965	18,188	6,063	236	3,839	87,204	93,140	74,263
Pseudo R^2	0.022	0.035	0.018	0.243	0.027	0.034	0.030	0.032

Note: (1) *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. (2) The numbers in parentheses are robust standard errors. (3) MSU1 is an overall indicator of medical service utilization for migrants after specific diseases, and MSU2 is an indicator of medical service utilization for migrants after the most recent illness. (4) The coefficients are presented as odds ratio.

a health-promoting effect on migrants in all subsamples. According to the empirical P values, regression coefficients of health education are significantly different within all groups. First, it is clear from Column 1 that health education has a health-promoting effect on both male and female migrants but stronger in females. Female migrants who received health education were 1.208 times more likely to have an improved self-rated health rating than those who did not receive health education, and this effect had a magnitude of 1.127 among male migrants. Second, according to the criteria of WHO to divide age groups, we classified the migrants aged 60 and above as the elderly. The results in Column 2 provide evidence that health education contributes to a greater health promotion among elderly migrants. Elderly migrants who received health education were 1.204 times more likely to have an improved self-rated health rating than elderly migrants who did not receive health education, and the magnitude of this effect was 1.162 among nonelderly migrants. Thirdly, considering the disparity in socioeconomic status between the groups with different education levels, we define junior college and above as higher education, and the results are shown in Column 3. Among migrants with higher levels of education, access to health education increased the probability of an improved self-rated health rating by a factor of 0.244 and this effect had a magnitude of 0.153 among migrants with no higher education. Finally, this paper examines the heterogeneous outcomes of migrants with or without chronic diseases after receiving health education. The results in Column 4 demonstrate that health education has a stronger health promotion effect on migrants without chronic diseases. Among migrants with chronic diseases, access to health education increased the probability of an improved self-rated health rating by a factor of 0.117 and the magnitude of this effect among migrants without chronic diseases was 0.174.

Table 7: Heterogeneous effects of health education on the health of migrants.

Variables	(1)		(2)		(3)		(4)	
	Ordered logit model							
	Gender		Age		Education		Chronic diseases	
	Female	Male	Nonelderly	Elderly	Nonhigher	Higher	Non	Yes
Healthedu	1.208***	1.127***	1.162***	1.204***	1.153***	1.244***	1.174***	1.117**
	(0.029)	(0.027)	(0.021)	(0.063)	(0.021)	(0.061)	(0.021)	(0.052)
Gender	—	—	1.188***	1.156***	1.183***	1.122***	1.182***	1.196***
	—	—	(0.019)	(0.064)	(0.020)	(0.050)	(0.019)	(0.055)
Age	0.951***	0.959***	0.953***	0.959***	0.955***	0.952***	0.952***	0.972***
	(0.001)	(0.001)	(0.001)	(0.005)	(0.001)	(0.003)	(0.001)	(0.002)
Education	1.041***	1.031***	1.035***	1.049***	1.051***	1.033	1.036***	1.041***
	(0.004)	(0.004)	(0.003)	(0.007)	(0.003)	(0.027)	(0.003)	(0.007)
Ethnicity	1.202***	1.050	1.139***	1.064	1.109***	1.175**	1.145***	1.024
	(0.043)	(0.040)	(0.031)	(0.097)	(0.031)	(0.089)	(0.031)	(0.080)
Cdisease	0.245***	0.243***	0.224***	0.350***	0.248***	0.212***	—	—
	(0.010)	(0.008)	(0.006)	(0.019)	(0.007)	(0.022)	—	—
Primary industry	1.073	1.631***	1.251***	1.558***	1.287***	1.468*	1.260***	1.397***
	(0.075)	(0.109)	(0.063)	(0.239)	(0.063)	(0.340)	(0.065)	(0.179)
Secondary industry	1.445***	2.121***	1.663***	2.300***	1.683***	1.316***	1.637***	2.019***
	(0.044)	(0.076)	(0.040)	(0.253)	(0.040)	(0.089)	(0.039)	(0.140)
Tertiary industry	1.528***	2.089***	1.689***	1.830***	1.705***	1.296***	1.657***	1.947***
	(0.037)	(0.070)	(0.036)	(0.122)	(0.035)	(0.079)	(0.034)	(0.112)
Insurance	0.897***	0.946**	0.932***	0.896	0.945***	1.012	0.917***	0.946
	(0.023)	(0.024)	(0.017)	(0.066)	(0.019)	(0.045)	(0.018)	(0.050)
Marriage	0.940*	0.951	0.993	0.882*	0.966	0.962	0.994	0.902
	(0.031)	(0.031)	(0.025)	(0.062)	(0.025)	(0.055)	(0.024)	(0.066)
Income	1.395***	1.398***	1.363***	1.465***	1.462***	1.103**	1.363***	1.496***
	(0.033)	(0.033)	(0.025)	(0.063)	(0.026)	(0.050)	(0.025)	(0.062)
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	73,468	77,618	144,845	6241	124,116	26,970	142,271	8815
Pseudo R^2	0.131	0.120	0.094	0.097	0.126	0.081	0.078	0.078
Empirical P value	0.005***		0.012**		0.015**		0.090*	

Note: (1) *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. (2) The numbers in parentheses are robust standard errors. (3) The coefficients are presented as odds ratio. (4) The "empirical P value" is obtained by Fisher's permutation test and used to test the significance of the difference in the coefficients of health education within groups.

4. Discussion

4.1. Main Findings. In recent years, China has made great efforts to promote the health of migrants through vigorous reforms [18, 19]. However, as a vulnerable group, Chinese migrant workers face inequalities in healthcare coverage, healthcare utilization, and other aspects of health [48]. In addition to reform actions such as the healthcare system and the supply of healthcare resources, research is increasingly recognizing the important role of health education.

Our study found that health education effectively promotes the health of migrants, and this finding is an empirical addition to the research on the health promotion effects of health education [49, 50]. Our study also found that consultative health education was more effective in promoting the health of migrants. Through consultative health education, migrants have access to health information that is more relevant to their own health status and therefore may improve their health through channels such as preventing work-related illnesses and improving personal lifestyle. As discussed before, according to the KAP theory, health education directly transmits health knowledge to migrants, which will improve migrants' health attitudes and ultimately promote the adoption of positive health behaviors to improve their health. Our study found that health education did increase medical service utilization after illness among migrants, implying an important role of health education in promoting health behaviors among migrants. In global KAP practices, health knowledge has shown a positive correlation with health behaviors that include disease prevention and health improvement behaviors [51]. For example, a higher COVID-19 knowledge score was significantly associated with a lower likelihood of adopting negative attitudes and potentially dangerous practices regarding the prevalence of COVID-19 [52]. The application of KAP theory to migrants also found that improving health knowledge was associated with improved physical activity levels, diet, and stress management among migrants [34]. This study, on the other hand, found that improved health knowledge among migrants through health education was associated with higher

levels of health improvement behaviors, which is the most recent empirical supplement to the KAP theory among migrants.

Our study also provides extensive information on heterogeneity. First, we find that health education has a stronger health promotion effect on female migrants, and this is consistent with previous studies that found females were more willing to receive health education and change traditional health beliefs [47, 53]. Another explanation from a life expectancy perspective is that females have a longer life expectancy compared to males [54]. Improving health provides greater future health benefits for females, so female migrants are more likely to take actions to promote their health after receiving health education compared to men. Second, our study found that health education has a greater impact on elderly migrants. This is consistent with other studies that show a greater impact of external interventions on elderly [55]. However, studies found that younger migrants received more health education [47], and they had lower health care utilization [56]. These studies help understand the differential effects of health education among migrants of different ages. Although younger migrants receive more health education, they make fewer improvements in health behaviors, resulting in limited facilitation of their health status by health education. Thirdly, health education is more effective for migrants with higher levels of education. Socioeconomic status has been shown to be associated with health status [57], and migrants with higher levels of education have a better health education [47], as well as higher levels of utilization of medical services [56]. The other possible explanation is that migrants with higher levels of education have a higher level of health literacy, value health more, have a better understanding of health knowledge, and also have a stronger ability to improve their health [21], and therefore, health education is more effective for them compared to those without higher education.

Finally, our study found that health education was more effective in promoting health among migrants with chronic diseases than those without chronic diseases. There is a scarcity of examination about health education among Chinese migrants with chronic diseases. A potential explanation is that chronic diseases are characterized by a long-term situation, which needs to be controlled by patient self-management [58]. After the diagnosis of a chronic disease, migrants have a higher level of demand for health information and access to health knowledge in order to manage their condition [59], and their health attitudes and health behaviors have improved. Thus, compared to migrants without chronic diseases, the impact of health education on them is smaller but still exists.

4.2. Policy Implications. Based on the research findings, this study proposes the following policy implications. For migrants, it is important to recognize the important impact of health education on their health and actively participate in health education campaigns launched by the inflow cities. From the 2017 CMDS, there are still 26.80% of migrants who have not received any health education. Migrants should recognize their lack of health knowledge, obtain relevant health information through health education, and adopt healthier behaviors to maintain their health. For the governments, it is important to pay attention to the health disadvantages of migrants and their important role in the prevention and control of COVID-19. First, the government can work together with labor unions or other NGOs to promote health education campaigns to include more migrants in health education and reduce health inequalities among migrants. Second, local governments should support communities, hospitals, and other institutions to carry out health education and provide appropriate resources and guidance, such as encouraging more effective consultative health education. Third, governments should adopt a differentiated and targeted method of health education by considering the gender, age, and occupation of migrants. Attention should be delivered to female and elderly migrants because health education is more effective for them.

4.3. Limitations. First, despite the use of multiple methods to enhance the reliability of the results, this is a cross-sectional data study due to data limitations. Future studies with panel data will make causal inferences more robust and reliable. Second, the data for this study are from China; however, the practical situation varies between countries and using data from other countries could increase the applicability of this study. Third, recent research gradually recognizes the shortcomings of low health literacy among migrants and pointed that health literacy has a strong impact on migration health and the quality of health care system [25, 60]. Although research has been conducted to provide a simple measure of health literacy among migrants using the CMDS [56], given that health literacy is a comprehensive and complex concept, future research could examine the health literacy of Chinese migrants more thoroughly.

5. Conclusion

This study shows that health education could motivate migrants to adopt healthier behaviors and improve their health. Among all the ways of health education, consultation is a more effective method. In addition, there is a greater need for health education for female and elderly migrants. Timely interventions for health education before migrants catch chronic diseases are also of great importance. This study helps us realize that the important impact of health education on the health of migrants. Future research should continue to discuss the factors that influence the health of migrants and make efforts to reduce health inequalities.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors' Contributions

Yihao Tian led and designed the study and led the data collection, analysis, and interpretation. Tao Luo contributed to the study design, provided input into the data analysis, and wrote the first draft of the manuscript. Ying Jiang contributed to the study design, reviewed the manuscript, and helped in the writing of the final draft of the manuscript. All the authors have read the final manuscript and approved the submission of the paper.

Acknowledgments

This work was supported by the 2022 National Social Science Fund Western Project: Research on the Formation Mechanism and Improvement Strategy of Migrants Health Literacy (grant number: 22XRK003).

Supplementary Materials

Table S1: description of variables. Table S2: the results of the balance test of the PSM method. Figure S1: differences in variables between the treatment and control groups before and after matching. (*Supplementary Materials*)

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